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ELECTRONICS AND ELECTRICAL ENGINEERING

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USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 105

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PIEZOSEMICONDUCTOR IN ALTERNATING ELECTRIC FIELD AS ACTIVE MEDIUM FOR GENERATION OF ACOUSTIC SIGNALS

Leningrad PIS'MA V ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 9, No 1, 12 Jan 83 pp 35-37

BORITKO, S. V., GULYAYEV, Yu. V. and MANSFEL'D, G. D.

[Abstract] An acoustic analog of a laser is considered, namely a semiconductor crystal through which acoustic waves propagate in a nonsinusoidally alternating electric field. The acoustic waves are specularly reflected by the boundary surfaces of the crystal and the period between their successive reflections is much longer than the period of the electric field. The amplification of acoustic waves in such a medium, regardless of their direction of propagation, is calculated on the basis of standard equations according to the linear theory of acoustoelectron interaction. The maximum average gain is attainable in a square-wave electric field of amplitude and frequency depending on the electron mobility and the Debye radius as well as on the frequency and the velocity of acoustic waves. A model material for experimental verification is n-InSb at 77 K, an adjustable transverse magnetic field providing excellent means of regulating the electron mobility and thus several parameters on which the amplification depends. High-intensity acoustic vibrations within 50 MHz wide frequency bands in the gigahertz range were detected in 4-8 mm long crystals upon application of an electric field with a 0.5 microsecond pulse duration and shorter than 30 ns pulse rise time. Two intensity peaks were found to occur at each level of the magnetic field intensity, their frequencies being in a 0.68 ratio. Figures 1; references 6: 4 Russian, 2 Western. [173-2415]

EFFECT OF GEOMAGNETIC FIELD ON DIFFUSION OF METEORIC TRAILS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 16 Feb 82) pp 1240-1243

LEVITSKIY, S. M., ABDRAKHMANOV, N. and TIMCHENKO, V. P., Kiev State University

[Abstract] Ambipolar diffusion of plasma clusters in ambient plasma is analyzed, considering that in the case of sufficiently large plasma density perturbations the density of ambient plasma will be too low for "short circuiting" and with the ambipolarity criterion defined accordingly as $h = N_0 / 8\pi n_0 \sqrt{D_{i\perp} D_e} \gg 1$ (N_0 - number of electrons per unit length of column, n_0 - electron concentration in ambient plasma, t - diffusion time, $D_{i\perp}$ - diffusion coefficient for ions across the magnetic field, $\tilde{D}_e = D_{e\parallel} \sin^2 \vartheta + D_{e\perp} \cos^2 \vartheta$, $D_{e\parallel}$ - diffusion coefficient for electrons along the magnetic field, $D_{e\perp}$ - diffusion coefficient for electrons across the magnetic field, ϑ - angle between axis of plasma column formed by meteoric trail in the ionosphere and axis of the geomagnetic field). When $\vartheta > \vartheta_0 = [x_1/x_e(1+x_1)^2]^{1/4}$ ($x_1, x_e = (\omega_H/\nu)_{i,e}$, ω_H - cyclotron frequency, ν - frequency of collisions between respective charged particles and neutral molecules), as is the case at 90-110 km altitudes, then the Hall effect is negligible. On this basis, with given estimates of diffusion coefficients and electron concentration, $h = 0.6$ during the day and $h = 60$ during the night at 93 km altitude for undercondensed meteoric trails ($N_0 \approx 10^{13} \text{ m}^{-1}$) occurring within fractions of a second ($t = 0.2 \text{ s}$). Observations of trails were made on Geminides, 12-14 December 1980 and 13-14 December 1981, using a transmitter of 20 kW - 33.8 MHz pulses at a repetition rate of 500 Hz with five-element "wave channel" transmitter and receiver antennas. The peak of the major lobe on the radiation pattern was at a 60-70° angle. The data have been processed into histograms depicting the duration distribution of meteoric radio echos when observed from the side of the minor axis (P-point) and from the side of the major axis (Q-point) of ellipsoidal trails. Figures 1; references 16: 10 Russian, 6 Western.

[157-2415]

OPTICAL METHODS OF FORMING CONTROL SIGNALS IN ADAPTIVE SYSTEMS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 25, No 10, Oct 82 (manuscript received 9 Nov 81) pp 1179-1187

VORONTSOV, M. A. and SHMAL'GAUZEN, V. I., Moscow State University

[Abstract] Wavefront correction in adaptive optics requires a control algorithm based on some performance criterion and its optimization. While the method of aperture probing is universal, it requires test variations of the wave phase for generating corrector control signals. An optical method involving filtration of the scattered field without introducing phase variations is proposed instead. It is based on a spectral criterion of focusing, the gradients of which depend on the complex amplitude of the scattered field and on the type of corrector, the functional being a natural generalization of the interference criterion. The corresponding conservation integral is defined for recording in a plane directly before the wavefront corrector. There are two recording channels: two lenses and a point diaphragm for forming a plane reference wave, two lenses and a space filter in their common focal plane for forming a wave with complex amplitude. Two adaptive optical systems are described where the corrector has several degrees of freedom and phase coupling does not require test variations. In one execution of the algorithm requires recording the phase profile of the scattered field in real time, with devices such as Hartmann probes, and inserting the correction. In another one the phase does not have to be measured directly, the gradients of the spectral criterion being obtainable by means of an optical system which includes a master oscillator, three photodetectors, three phase detectors, and a scanning mirror. The number of recording channels can be reduced to one, if special but simple processing is added. Figures 4; references 6: 5 Russian, 1 Western in translation.
[156-2415]

UDC 537.521.7

EXTREMALITY OF DEPENDENCE OF BREAKDOWN DEVELOPMENT TIME ON MAGNETIC FIELD INTENSITY

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 21 Sep 81) pp 1256-1259

KISHOV, M.-R. G. and EFENDIYEV, A. Z., Dagestan State University

[Abstract] A functional dependence of the breakdown development time τ_0 in helium on the magnetic field intensity H in the undervoltage region has been obtained which reveals the τ_0 first decreases 15-20% to a minimum as H increases from 0 to H_{crit} (50-60 kOe) and then again increases monotonically with further increase of H . In nitrogen τ_0 has been found to first increase to a

maximum and then decrease monotonically in the undervoltage region and to decrease monotonically throughout without a minimum in the overvoltage region. Individual avalanches do not explain the extremality of this dependence in the undervoltage region, but interaction of avalanches and field distortion in the interelectrode space by space charge may. Results of experimental studies made with the use of an electron-optical converter and an oscillograph do not definitely confirm the additional mechanism of ionization buildup, but indicate that resultant microfields produced by charges in avalanche tips (-) and by avalanche flashovers (+) affect the discharge processes later than do the field of avalanche tips alone. They also confirm the periodicity of channel formation and agree with the multiavalanche model of breakdown ("apparent shift of anode toward cathode"). Optical measurements in a magnetic field are not yet adequate for ascertaining the phenomena in gas-discharge gaps, because of the limited resolving power of instruments. Figures 4; references 4: 2 Russian, 2 Western (1 in translation). [157-2415]

UDC 538.574.7

ANALYTICAL STUDY OF SCATTERING CHARACTERISTICS OF STRUCTURE COMPRISING TWO OPEN CYLINDRICAL SHIELDS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 10, Oct 82 (manuscript received 13 Nov 81) pp 1170-1178

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[Abstract] An analytic solution is obtained for the problem of diffraction of a plane H-polarized electromagnetic wave by a pair of longitudinally slit circular cylinders. Explicit expressions are obtained by the method of rereflections, first for an array of N such cylinders, taking into account their pronounced resonance characteristics. The complexity of the general solution is greatly reduced in the special case of only two such cylinders. Most interesting is excitation of quasi-natural "slot" modes. The cross section for total scattering as a function of the wave parameter and the maximum cross section for total scattering as a function of the distance between cylinders are calculated so as to reveal the effect of coupling between them. The author thanks V. P. Shestopalov and E. I. Veliyev for their interest and valuable comments. Figures 3; references 9: 4 Russian, 5 Western. [156-2415]

CHANGE IN SPECTRUM OF ELECTRON CONCENTRATION NONUNIFORMITY IN LOWER IONOSPHERE CAUSED BY STRONG ELECTROMAGNETIC RADIATION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 28 Dec 81) pp 1244-1248

TEPTIN, G. M. and STENIN, Yu. M., Kazan State University

[Abstract] The effect of strong electromagnetic radiation on the lower ionosphere, specifically on turbulent fluctuations of the electron concentration, is analyzed by reducing the three-dimensional spectrum of these fluctuations to a one-dimensional one. The spectrum covers a range of inhomogeneity scales from very small to 600 m large and the coefficient of ambipolar diffusion is assumed to be equal to that in an isotropic plasma. Strong electromagnetic radiation is found to change three parameters determining the fluctuation spectrum: diffusion coefficient, smallest turbulence scale, and mean electron concentration. Calculations taking into account the effect of the geomagnetic field on the electron temperature during heating reveal a redistribution of the turbulence intensity within the spectrum, namely attenuation of small-scale fluctuations and amplification of large-scale ones. The magnitude of a signal scattered by such inhomogeneities can change accordingly. Numerical results have been obtained for electromagnetic radiation emitted vertically upward from a 6.4 MW equivalent power source at a frequency of 1.35 MHz. The authors thank L. M. Yerukhimov for helpful discussion of problems considered in this study. Figures 2; tables 3; references 10: 9 Russian, 1 Western. [157-2415]

MECHANISM OF NONLINEAR CANALIZATION OF LOW-FREQUENCY WAVES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 10, Oct 82 (manuscript received 12 Jan 82) pp 1109-1114

MOLCHANOV, O. A., MAL'TSEVA, O. A. and SHARKO, I. Ye., Rostov-na-Donu State University

[Abstract] Nonlinear canalization of low-frequency waves in the earth's magnetosphere is considered as a three-wave interaction process which involves a transverse ioncyclotron wave existing near the equatorial plane in the L_1 -region and a VLF howl wave propagating through this region, both wave generating a new howl wave if the condition of phase synchronism is satisfied. The space and time scales of this process are evaluated from the wave equations for amplitudes of a three-wave "merging" process. The possibility of nonlinear canalization is then demonstrated on a 15 kHz wave and a 2.6 radiator L-shell. The propagation characteristics of VLF waves along their trajectory are calculated first without and then with nonlinear canalization effects taken into

account, consideration of either strong or weak canalization requiring two different calculation algorithms. The results provide a fair interpretation of experimental results obtained with an intermediate-latitude VLF radiator. Figures 4; references 7: 4 Russian, 3 Western.
[156-2415]

UDC 621.371.3:535.36

AMPLIFICATION EFFECT IN BACKSCATTERING OF WAVES BY ROUGH SURFACES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 6 Jan 82) pp 1291-1295

ZAVOROTNYI, V. U. and OSTASHEV, V. Ye., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] Backscattering of waves by a surface with two-scale roughness, equivalent to one surface with large-scale (relative to the wavelength) roughness and a scatterer with microroughness, is analyzed in an up to the first-order approximation of perturbation theory. Calculations are made for a pair of large plane soft surfaces at an angle to each other with a common edge, both of finite dimensions, a point source and a receiver. With re-reflections from one surface to another included, components of field intensity at the source location are found which represent backscattering by each surface if it were alone. These two components add coherently and thus produce amplification, but only when the distance between source and receiver is sufficiently small. A third component represents the mutual influence of the two surfaces on one another, this effect being purely energetical and noncoherent in nature. These amplification effects are attributable to multipath propagation of waves following multiple specular reflections, in addition to amplification which takes place in a randomly nonhomogeneous medium. The authors thank V. I. Tatarskiy, A. S. Gurvich and I. G. Yakushkin for helpful comments. Figures 2; references: 6 Russian.
[157-2415]

UDC 621.371.029.65(260)

STATISTICAL CHARACTERISTICS OF FIELD OF CENTIMETRIC AND MILLIMETRIC WAVES ABOVE SEA SURFACE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 14 Sep 81, after completion 23 Jun 82) pp 1260-1268

BALAN, M. G., BESPECHNYI, C. B., GORBACH, N. V., PEDENKO, Yu. A. and Razkazovskiy, V. B., Institute of Radiophysics and Electronics, USSR Academy of Sciences

[Abstract] Experimental studies were made for the purpose of gathering data on the statistical characteristics of the field of centimetric and millimetric

waves above the sea surface. Measurements were made under various conditions over two fixed routes, a long one (16 km) and a short one (0.75 km), with one transmitter and four receivers (wavelengths: 3.2 cm, 8 mm) or two receivers (wavelength: 2 mm) as well as with one transmitter on a barge moving radially 7-8 km far from one receiver (wavelengths: 8 mm, 4 mm). All measurements were made during spring and summer. The data have been processed mathematically in order to yield the distribution of signal amplitude fluctuations, the diffuse-scattering coefficients, and the cross-correlation coefficients for field amplitudes in the case of two or four receivers spaced apart. The signal amplitude fluctuations over a long route can be approximately regarded to have a Rice distribution or a Rayleigh distribution. Over a short route their distribution departs from those and approaches one corresponding to only a few reflections. The diffuse-scattering coefficients correspond to a 0.05 surface roughness. The cross-correlation coefficients in the horizontal plane are always positive and close to unity, even at the largest distance between receiver antennas, the cross-correlation coefficients in the vertical plane are alternately positive and negative. Figures 4; tables 2; references 16: 8 Russian, 8 Western (2 in translation). [157-2415]

UDC 621.371.246

MEASUREMENT OF ATMOSPHERIC ABSORPTION AND BRIGHTNESS TEMPERATURE AT MILLIMETRIC WAVELENGTHS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 12 Jun 81, after revision 27 Apr 82) pp 1269-1278

PELYUSHENKO, S. A., Scientific Research Institute of Radiophysics

[Abstract] Measurements of total vertical absorption in the atmosphere were made at millimetric wavelengths (6.3, 6.7, 8.3 mm) by the Bouguer method based on attenuation of r-f radiation from extraterrestrial sources, sun and moon, as well as by the "atmospheric profile" method based on intrinsic atmospheric radiation. The measurements were made with a reflector 0.6 m in diameter on the antenna and a two-channel (6 mm, 8 mm) radiometer. They were made during the June-September 1982 period, 46 measurement cycles by the second method and 30 of them by the first method. During the measurements the absolute humidity p_0 at the earth surface varied over the 5-18 g/m³, the mean ambient temperature was 291±2.9 K and the mean pressure was 995±35 mbar. The accuracy of absorption measurements by both methods has been evaluated on the basis on the exponential relation between absorption coefficient and brightness temperature of the atmosphere $T_{atm}(\theta) = T_0(1 - e^{-\Gamma \csc \theta}) = bHS(\Gamma \csc \theta)$. $e^{-\Gamma \csc \theta}$ (T_0 - temperature at earth surface, $\theta > 6^\circ$ - elevation angle of radiation source, b - vertical temperature gradient, H - effective length of radiation path). A statistical analysis of the data reveals that the dependence of the absorption coefficient on atmospheric humidity is more closely approximated, with a smaller dispersion, by the

quadratic relation $\Gamma = A + B\rho_0 + C\rho_0^2$ than by the linear relation $\Gamma = \alpha_0 H_{O_2} + \alpha \rho_0 H_{H_2O}$ ($\alpha = \kappa_{H_2O}/\rho_0$; α_0, α - absorption coefficients for oxygen and water vapor respectively). The departure from linearity is attributable either to systematic deviations of the humidity distribution in the atmosphere from theoretical or to a nonlinear relation between total mass of water vapor along the line of sight and absolute humidity at the earth surface within the given range. The errors of both methods and their attainable accuracy are evaluated on this basis, the two methods correlating with a nearly one-to-one correspondence. The author thanks N. M. Tseytlin for his interest and helpful discussion, also V. V. Snegirova and L. V. Dmitrenko for assisting with measurements. Figures 6; tables 2; references 13: 12 Russian, 1 Western. [157-2415]

UDC 621.372.85

PROPAGATION OF SURFACE WAVE ALONG DIELECTRIC WAVEGUIDE WITH JUMP CHANGE OF PARAMETERS, PART 1: SOLUTION BY FACTORIZATION METHOD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 2 Feb 82) pp 1329-1336

MANENKOV, A. B., Institute of Physics Problems, USSR Academy of Sciences

[Abstract] The vector problem of diffraction of a surface wave at jumplike irregularities is solved for thin anisotropic dielectric waveguides, with a diameter smaller than the wavelength. The analysis is based on spectral resolution of fields into a continuous spectrum of natural modes and a discrete spectrum of surface-wave modes. The integral equation for the field along the axis of a cylindrical waveguide, at the junction between two coaxial segments with different diameters, is reduced to a Wiener-Hopf equation and the latter is solved by the method of approximate factorization of Fourier transforms. A subsequent inverse Fourier transformation yields the field in the entire space. At the waveguide axis the field consists of three fields produced by incident, transmitted, and reflected surface waves, respectively, and the field produced by an ambient space wave. The reflection coefficient and the transmission coefficient are determined accordingly. The dielectric permittivity is assumed to be sufficiently small for linear polarization inside the waveguide. Two limited cases are evaluated, one with no second segment (zero diameter) and the problem reduced to diffraction of a surface wave at the end of a semilinear fiber. In the second case the difference between diameters of the two segments is small and energy is lost on excitation of a spherical wave at the junction. Calculations have been made for circular waveguides, reflection coefficient as a function of the wave number and axial distribution of the amplitude of the space-wave component of the field. The reflection coefficient at a jumplike irregularity is exponentially small and decreases fast with decreasing phase velocity of the surface wave, while radiative losses increase as the surface wave slows down. The author thanks P. L. Kapitsa for discussing the results. Figures 4; references 14: 6 Russian, 7 Western (1 in translation). [157-2415]

MULTISTAGE DIRECTIONAL COUPLERS USING LUMPED ELEMENTS

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received, after completion, 7 Apr 82) pp 61-64

STECHENKO, V. M.

[Abstract] Design of multistage wideband directional couplers with a minimum number of lumped elements is considered for superheterodyne receivers with a phase quadrature between voltages at different outputs. The performance characteristics of such directional couplers are determined on the basis of the transmission matrix, assuming lossless circuit elements and perfect magnetic coupling between inductance coils. Calculations are shown for 3-dB directional couplers with 2-6 stages, their performance parameters including the ratio of upper-to-lower corner frequencies, deviation from the ratio of complex amplitudes of output voltages, and normalized time constants of the stages. The ratio of voltage amplitudes has been obtained, in the form of a fractional-rational polynomial, by multiplying the matrices of individual elements. A low-frequency directional coupler requires a large ratio of inductance to coil length, which is attainable with a small ferrite core, and the product of its upper corner frequency by the ratio of upper-to-lower corner frequencies must not exceed 100-300 MHz. Figures 3; tables 1; references 5: 3 Russian, 2 Western.
[186-2415]

UDC 621.372.832

STANDARDIZED STEPPED DIRECTIONAL COUPLERS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 16 Jan 81) pp 55-57

KATS, B. M., MESHCHANOV, V. P. and BEREZHNOY, V. A.

[Abstract] The diversity and complexity of directional couplers built with transmission line segments for microwave applications require a standardization of their design and technology so as to ensure, among other, that all frequency ranges are covered without unnecessary duplication. Standardization of stepped couplers with air as dielectric filler has been proposed and evaluated. Class-2 devices are more suitable for this purpose than Class-1 devices. They comprise cascades of coupled and noncoupled transmission line segments of different lengths, the coupled segments satisfying the requirements of ideal matching and directivity with the same coupling coefficient throughout the line. In the standard version the inner conductor of each coupled segment is a circular cylinder adjoining a rectangular parallelepiped. These cylinders are coaxial with the inner conductors of the noncoupled segments and of the coaxial feeders, all having the same diameter. The standard series has been designed with a

Chebyshev or maximally flat crosstalk attenuation-frequency characteristic, a single-step coupler constituting the basic structural version, and then optimized experimentally. Three models of such directional couplers with a Chebyshev characteristic for the 0.3-1.3 GHz frequency band are already available: one symmetric with 3 ± 0.35 dB crosstalk attenuation and 90° phase shift between output signals, two asymmetric with 10 ± 0.72 dB and 20 ± 0.84 dB crosstalk attenuation respectively. Figures 5; references: 3 Russian. [172-2415]

UDC 621.372.852.1

HIGH-POWER ADDING AND SWITCHING STRIPLINE DEVICE

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 10 Oct 81) pp 52-55

ANTONENKO, V. M., BERLYAVSKIY, I. Z., MODEL', A. M. and CHUBIS, V. I.

[Abstract] An adding and switching device used in modern antenna feeder systems not only performs the two functions of adding the power of two coherent-signal transmitters and connecting either of two station transmitters, but also makes it possible to feed the total power or the power from either transmitter to a ballast load rather than to the antenna during preventive maintenance operations. Such a device consists of two directional couplers with 3 dB crosstalk attenuation and two phase shifters (0 or $+90^\circ$ and 0 or -90° respectively). A directional coupler consists of a stripline with three stubs. A phase shifter consists of a stripline segment with six specially designed short-circuiting stubs, each stub made in two parts with different characteristic impedances: one constant (of the part adjacent to the stripline segment) and one variable. The performance of this device has been evaluated experimentally but means of measurement of the frequency dependence of the VSWR from the input end and of the crosstalk attenuation. The crosstalk attenuation was measured between the two inputs as well as between one input and the output with the latter connected either to the ballast load or to the antenna. Figures 8; references: 4 Russian. [172-2415]

UDC 621.372.852.1

DESIGN OF WAVEGUIDE- DIELECTRIC FILTERS IN CUTOFF WAVEGUIDE

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 24 Mar 82) pp 52-54

AFROMEYEV, V. I.

[Abstract] An accurate method of designing waveguide-dielectric filters in a cutoff waveguide is shown, based on a low-frequency ladder prototype. It yields the geometrical dimensions which will ensure the necessary generalized

microwave performance characteristics. Synthesis of multistage filters is based on the mathematical model of a two-stage resonator with appropriate conversions, the number of resonators being either odd or even. In the former case only one symmetric half of the filter needs to be designed. In the latter case, such as that of a filter with a Chebyshev characteristic, its symmetric segments are of unequal lengths and these must be determined simultaneously from both input and output ends toward the center. Typical amplitude-frequency characteristics of the reflection coefficient at the input $|S_{11}|$ (in scattering matrix) are shown for a three-stage filter and a seven-stage filter of this kind designed by this method. A computer is not required for engineering calculations. Figures 3; references: 5 Russian. [186-2415]

UDC 621.372.853.8

RECTIFIER-FLANGES FOR 3-4 MM WAVE BAND USING HEXAFERRITES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 13 Aug 81) pp 75-76

AGAPOVA, N. N., BOCHKAREV, A. I., IVANOVA, V. I. and KURUSHIN, Ye. P.

[Abstract] Small rectifier-flanges for millimetric waves have recently been developed on the basis of E,H-plane T- and Y-circulators using normalized poly-crystalline ferrites. Further miniaturization is difficult, inasmuch as it involves their three basic components: ferrite resonator, load, and high-cost permanent magnet (SmCo). A study was made in order to determine the feasibility of a dielectric-hexaferrite resonator with elimination of the magnet, for rectifier-flanges used in such devices as oscillators with Gunn-effect or IMPATT diodes. Tests were performed and measurements were made with 06C4A2 hexaferrite (saturation magnetization $M_s=290$ G at 20°C and anisotropy field intensity $H_a=15$ kOe, loss tangent $\tan \alpha=4.10^{-4}$ and dielectric constant $\epsilon'=12.2$ for 3 cm wave band). The dependence of tuning frequency on resonator length was checked and found to be strong. An E-plane magnetless rectifier-flange for millimetric waves is not yet feasible, for this reason, but an H-plane version is. Figures 1; references 13: 11 Russian, 2 Western (1 in translation). [123-2415]

UDC 621.373-187.4

HIGH-SPEED DIGITAL FREQUENCY SYNTHESIZER WITH SMALL TUNING STEP

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 3 Jul 82) pp 80-82

NAZARENKO, V. M., IL'INSKIY, I. V. and POTSEPNYA, O. A.

[Abstract] A digital frequency synthesizer is described which produced an output frequency related to the reference frequency through the equality $f_{\text{out}} = (N + \frac{m}{q})f_{\text{ref}}$ (N, m, q , are integers and q is the lowest denominator). This

relation must be satisfied by instantaneous values of both frequencies, which requires a variable-quotient frequency divider, and within every interval of automatic tuning of the synchronizing generator. The structure of such a synthesizer includes, in addition to the frequency divider with coupling circuit and code comparator, a main phase detector and an auxiliary phase detector, each containing a sawtooth-voltage generator, a reference oscillator, a decoder, an adder with two switches on the input side and feeding into a sampling and storing device, a low-pass filter, a synchronizing generator, and an automatic slope control. The slope of the sawtooth voltage has been selected as the synthesizer design parameter. Absence of modulating fluctuations in the synchronizing generator eliminates extra filtration of its error signal, which contributes to a high speed of synthesizer operation with a tuning step q times smaller than that of a conventional digital frequency synthesizer. Figures 1; references: 3 Russian. [186-2415]

UDC 621.378.325

NUMERICAL METHOD OF ANALYSIS OF ADAPTIVE OPTICAL SYSTEMS FOR APERTURE PROBING

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 28 Jan 82) pp 1310-1318

VORONTSOV, M. A. and CHESNOKOV, S. S., Moscow State University

[Abstract] An adaptive optical system for focusing, by means of aperture probing, the radiation in a randomly nonhomogeneous weakly absorbing nonlinear medium is considered. It does not require test variations of the wavefront phase. The system consists of a wavefront corrector between transmitter aperture and object, with a detector and a control unit in the feedback loop from object to corrector. The system contains N control channels and is designed to maximize the sharpness-of-field criterion functional (integral of radial transmission profile) measurable in the receiver aperture. Assuming that increments of the criterion functional are proportional to its gradients, tedious numerical simulation through discretization in both time and space can be replaced by a numerical solution of auxiliary problems for the gradients of complex amplitude and phase of the electric field of both the incident wave and the scattered wave, in the corresponding two pairs of equations of wave propagation. The same equations need to be solved regardless of the number M of channels. The computation effort is the same for any number of degrees of freedom in the corrector. The algorithm also yields estimates of the maximum capability of aperture probing with suppression of turbulent and nonlinear distortions. This is illustrated on an ideal circular receiver aperture, a real one shifted from the transmitter aperture, and an annular receiver aperture such as one consisting of four circular apertures equidistant from the center. Figures 6; references 9: 6 Russian, 3 Western (1 in translation). [157-2415]

EFFECTS OF DESTABILIZING FACTORS ON ACCURACY OF DETERMINATION OF SIGNAL TIME COORDINATE

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 28 May 82)
pp 37-40

SHEMSHEDINOV, R. B.

[Abstract] Effects of destabilizing factors on the accuracy of determination of the time coordinate of radar signals are analyzed by comparing two of the most prevalent methods of such a determination for pulse signals with amplitude fluctuations. The first method uses the point where the output effect function is maximum; the second method uses the leading edge of the signal, i.e., the point where the output effect function crosses a given threshold level. A certain spread of the receiver triggering threshold is taken into account, but with the mean threshold assumed to be independent of the noise intensity (nonadditive system). The sensitivity of the system is assumed to be limited by the internal noise of the receiver. Assuming also a sufficiently high signal-to-noise ratio, the dispersion of the time determination error is calculated for both methods. The destabilizing effect is evaluated for three different signal statistics: log-normal distribution, uniform distribution, and gamma distribution. The accuracy of both methods of time coordinate determination is found to worsen as the variance coefficient of signal amplitude increases, but the rms noise error of the second method increases sooner and more appreciably. Figures 2; references 10: 8 Russian, 2 Western (in translation).
[186-2415]

UDC 621.391.827

APPROXIMATION OF ATMOSPHERIC RADIO INTERFERENCE IN ARCTIC REGION WITH HALL MODEL

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received, after completion, 6 Apr 82) pp 64-66

BASALAYEV, M. L.

[Abstract] The probability characteristics of atmospheric radio interference in Eastern Arctic regions (Cape Schmidt) were recently measured in the summer of 1977 at frequencies of 25, 35, and 50 kHz. Integral probability distribution functions for the envelope of this interference and the mean number of its overshoots above a fixed level have been determined on the basis of these measurements. The experimental data are best approximated analytically by the N. M. Hall model with $\theta = 4$ (parameter $\theta = 1 + m$ characterizes the dimensionality of the chi-square distribution). This model also yields an envelope with minimum deviations and also the mean number of its overshoots, the fit being closer with $\theta = 4$ than with $\theta = 3$ or 5. Figures 3; references 3: 2 Russian 1 Western.
[186-2415]

RADIATION PATTERN OF ARRAY OF CIRCULAR DIELECTRIC CYLINDERS EXCITED BY LOCAL SOURCE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 10, Oct 82 (manuscript received 16 Nov 81) pp 1188-1196

BYKOV, A. A. and IL'INSKIY, A. S., Moscow State University

[Abstract] Diffraction of radiation from a point source by an infinite linear periodic array of homogeneous dielectric circular cylinders is considered as a two-dimensional boundary-value problem. An analytical approximate solution to the corresponding ordinary differential Maxwell field equations for the regions of discontinuity of the dielectric permittivity is obtained by the method of integral transformation, uniqueness of the solution being ensured by satisfying the conditions of radiation. On this basis the asymptotic behavior is then calculated of the radiation pattern for such an array of scattering reflectors as the source moves away. A numerical solution to the problem is obtained by the incomplete Galerkin method, for a source moving closer to the array. The results reveal a change in the form of the radiation pattern as the source approaches the array, this change occurring with the source at a distance equal to a few periods of the array. Figures 5; references 9: 8 Russian, 1 Western in translation. [156-2415]

EFFECT OF SIGNAL PHASE FLUCTUATIONS ON MEASUREMENT CHARACTERISTICS OF RADAR STATION WITH SYNTHESIZED ANTENNA

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received after completion, 10 Feb 82) pp 14-17

SHKOL'NYY, L. A. and MOROZOV, L. M.

[Abstract] A radar station with a synthesized antenna is considered, where phase instability of the coherent transceiver and random deviations of the phase center of the antenna along the ranging path cause fluctuations of the signal phase. These fluctuations disrupt the pulse response describing the signal function and shift it along the range coordinate. Their effect on the measurement characteristics of such a radar station is analyzed by first determining the correlation function for geometrical distortions of the radar image and then estimating the error of distance measurement. Calculations are made for rectangular and bell-shaped envelopes of the pulse response of the processing system. Figures 3; references 7: 6 Russian, 1 Western in translation. [186-2415]

METHOD OF POSTDETECTION PROCESSING OF PULSE SIGNALS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received after completion, 15 Dec 81) pp 55-57

LEVASHEV, A. Yu.

[Abstract] In order to ensure detection of pulse signals by an amplitude detector with high interference immunity and without distortion, it is necessary statistically to process the overshoots above the threshold level at the detector output. The threshold constitutes a constant voltage dependent on the false-alarm probability, and the duration of an overshoot is best characterized dimensionlessly as the product of the actual overshoot time by the bandwidth of the linear receiver component. Considering that overshoots of short duration dominate in the envelope of a narrow-band normal process and their fraction of all overshoots increases with rising threshold level, the parameter of the relative difference of two processes and a corresponding decision rule are used for calculating the false-alarm probability and the missed-hit probability as functions of the ratio of the threshold voltage to the rms deviation of narrow-band noise, as well as the probability of exceeding the threshold as a function of time. The results indicate that this method of detection makes it possible to lower appreciably the probabilities of false alarm and missed hit or, for a given false-alarm probability, to lower appreciably the detection threshold and thus increase the sensitivity of the receiver. Figures 3; references: 2 Russian.
[123-2415]

UDC 621.396.95:523.164

CONTROL OF RADIATION PATTERN OF LARGE RADIO TELESCOPES BY MEANS OF PHASING ARRAYS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 24 Dec 81) pp 49-52

KUTUZOV, S. M.

[Abstract] Antennas for large radio telescopes consist of arrays of 10^5 - 10^6 weakly directional radiators. While the radiation pattern of such an array is usually controlled by means of phase shifters, a phasing array placed at the feeder output and producing a multibeam radiation pattern will improve the telescope output characteristics. Here the design of such a phasing array is analyzed from the standpoint of multilevel staging for overall size reduction without sacrifice in the transmission coefficient. The principle is demonstrated on a two-level pattern forming system and calculation of the amplitude distribution in it, three-level and further staging being quite feasible. A two-level system of 17 16×16 Butler phasing arrays has been proposed and evaluated

for the second radiation pattern in the H-plane of the BSA radio telescope at the Institute of Physics, USSR Academy of Sciences, to be controlled independently of the first one. Such a phasing system has a very stable transmission coefficient and the number of switching elements in it is one order of magnitude smaller than in a comparable system of discrete phase shifters ensuring the same minimum interaction of adjacent beams. However, the partial radiation patterns here are not completely decoupled and are rigidly tied to the antenna's system of coordinates. The author thanks V. A. Udal'tsov for helpful suggestions and comments. Figures 2; references 8: 5 Russian, 3 Western. [172-2415]

UDC 621.396.96

NORMALIZING DURING INVARIANT DETECTION OF SIGNALS SUBMERGED IN PASSIVE BACKGROUND INTERFERENCE

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 25 Feb 82) pp 17-19

GOL'FEL'D, G. B., BARTENEV, V. G. and SHLOMA, A. M.

[Abstract] Detection with stable false-alarm probability is considered in the case of pulse signals submerged in normal passive background interference with unknown correlation characteristics. The problem of determining the quantity which will normalize the dispersion of "measurements noise" is solved by the method of time autoregression analysis. A recurrence relation between partial correlation coefficients and autocorrelation coefficients for centered sample elements is found from the solution to the corresponding system of Hule-Walker linear equations. Application of the result to a Markov process and a Hule process reveals that the intensity of "measurements noise" decreases as the correlation between readings becomes stronger. References 5: 4 Russian, 1 Western in translation. [186-2415]

UDC 621.396.96:621.391.26

ACCURACY OF MEASUREMENTS OF ANGULAR COORDINATE DURING DISCRETE SCANNING OF ANTENNA BEAM

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 28 Dec 81) pp 24-26

POPOV, D. I.

[Abstract] Discrete plane scanning of the radiation pattern is considered for direction finding with electronic control of the antenna beam in phased antenna arrays. The angular coordinate is measured by the two-position method, with

the target within the sector between the directions of two radiation intensity peaks. The error of such measurements is evaluated here, assuming that the statistical characteristics of signal and interference do not change during sweep from two adjacent (discrete) positions of the antenna beam. Calculations are based on maximum-likelihood estimates of the target angle and Rao-Kramer estimates of their dispersion. In the specific case of a radiation pattern with a Gaussian major lobe better accuracy is found to be attainable by discrete scanning than by linear scanning at the same scan rate and with the same volume of sampled data. Figures 2; references: 5 Russian. [123-2415]

UDC 621.396.677

NOISE TEMPERATURE AND NOISE FIGURE-OF-MERIT FOR NONAXISYMMETRIC REFLECTOR ANTENNAS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 15 May 80)
pp 57-60

SOMOV, A. M.

[Abstract] A reflector antenna is considered with the reflector constituting a nonaxisymmetric segment of a paraboloid of revolution and with the phase center of the radiator lying at the focus of that paraboloid. Locating the radiator beyond the range of the reflected field eliminates shading of the antenna aperture and thus increases the aperture surface utilization, reduces the feedback from reflected field to radiator, and relaxes the manufacturing tolerances for the reflector surface. Such a configuration also lowers the noise temperature during operation at low angles, which is particularly advantageous in the case of ground antennas for satellite communication systems. Aperture radiation in the principal planes and the radiation pattern of an outlying radiator are axisymmetric, which makes possible separate evaluation of ambient noise and noise from scattered fields. The radiation field and its characteristics are calculated on this basis. The noise temperature of such an antenna has been evaluated as a function of the antenna beam elevation angle, including the contribution of thermal radiation from a smooth earth surface with an emissivity $\epsilon = 3.5$ at 4 GHz. This contribution is negligible at low angles, unlike in the case of axisymmetric reflector antennas, and the noise temperature increases with increasing angle but not more than 20 K as the elevation angle increases from 20 to 90°. The noise figure-of-merit (ratio of antenna gain to receiver noise temperature, referred to the input of a low-noise amplifier and taking into account noise in this amplifier as well as in the antenna-feeder channel) has also been evaluated. Figures 5; references: 5 Russian. [172-2415]

USE OF INTEGRAL EQUATIONS OF SECOND KIND FOR ANALYSIS OF DIFFRACTION BY THIN SHIELDS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 10, Oct 82 (manuscript received 23 Mar 82) pp 1099-1101

INSPEKTOROV, E. M., Gomel State University

[Abstract] The feasibility of using a Fredholm integral equation of the second kind for analysis of diffraction by thin finite-thickness shields is examined in the specific case of an H-mode wave at a cylindrical shield. The shield, excited from an E-sectoral horn radiator, is assumed to be ideally conducting. The problem is formulated in two systems of coordinates, a Cartesian one and an orthogonal curvilinear one. The corresponding integral equation for the electric surface current is solved numerically, by subdivision of the shield contour into N intervals and reduction of the equation to a system of algebraic ones. The magnetic field outside the shield is regarded as equal to the sum of the field caused by external currents (in the horn) and the field caused by currents induced in the shield. The order of the system of algebraic equations, which becomes very high in the case of a long shield contour, can be reduced appreciably by considering that the currents on the shadow side of the shield decrease rapidly with an increasing distance from the shield and assuming that they become zero at some distance between the shadow-light boundaries. Calculations have been made for a shield in the form of a cylindrical shell of radius $R = 3.2\lambda$ and chord length $C = 4.5\lambda$, its half-thickness a varied from 0.0321λ to 0.125λ and with the distance of the two shadow-light boundary lines on the back surface of the shield from the corresponding shield wages varied from 0.25λ to λ (λ - wavelength of incident radiation). The number of intervals N was selected sufficiently large to make the nondiagonal coefficients in the system of algebraic equations $|S_{pq}| < 0.35$ in each case. The results of calculations include the current distribution on the shadow side of the shield, normalized to the current at the center of the illuminated side, as a function of the distance from the center on the shadow side. They also include the attenuation of the magnetic field on the shadow side of the shield, relative to the incident magnetic field, as a function of the distance from the shield. Decreasing the shield thickness is found to affect most strongly the current distribution on the shadow side. Figures 3; references 6: 3 Russian, 3 Western (1 in translation). [156-2415]

LAWS OF CROSS-POLARIZED RADIATION FROM DIELECTRIC RADIO LENSES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 28 Oct 81)
pp 70-74

NARBUT, V. P. and GOLOD, A. P.

[Abstract] Cross-polarized radiation from focusing dielectric lens antennas is examined on the basis of the vector diagram, on which its modulus is plotted together with the modulus of the fundamental radiation component. The analysis is based on the aperture method with asymptotic calculation of the vector diagram for optical antennas, using the concept of idealized radiator and the concept of cross-polarized field distribution in the antenna aperture. An idealized radiator is a point radiator with polarization characteristic equivalent to that of a "electric dipole and magnetic dipole" combination with given radiation pattern parameters. Calculations for convex-plane or hyperbolic and concave-convex or elliptic lenses, based on theoretical relations for the field components with given lens geometry and given fundamental field component, reveal that the cross-polarization level with such lenses is higher near the antenna axis than in the case of a parabolic antenna with the same ratio F/D of focal length to diameter and the same field level at the edge Δ . The cross-polarization level depends on F/D and Δ , as well as on the ratio of electric dipole moment to magnetic dipole moment, just as in the case of reflector antennas, but not much on the refractive index. Figures 8; tables 1; references 7: 6 Russian, 1 Western (in translation). [123-2415]

UDC 621.396.677.001.5

DEPENDENCE OF PERFORMANCE OF LONG SHORT-WAVE RADIO TRANSMISSION LINE ON RADIATION PATTERN OF ANTENNA

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received after completion, 11 Jan 82) pp 46-49

ZHIL'TSOV, A. U. and KOROLENKOV, A. V.

[Abstract] The effectiveness of long-distance short-wave radio broadcasting with synphasal transmitter antennas is studied for the purpose of determining the optimum angular width of the radiation sector in the vertical plane. A transmitter antenna SGD 8/n with eight horizontal tiers of $n/2$ vibrators in each was used as receiver antenna, with a rhombic transmitter antenna. This is permissible according to the reciprocity principle and simplifies the experimental procedure although not exactly simulating actual conditions of radio reception with a rod antenna. The particular SGD antenna had a total of eight symmetric vibrators ($n=2$) and was tested with: 1) Synphasal connection

of vibrator groups; 2) Antiphasal connection of vibrator groups; 3) Connection of only the lower vibrator group (SGD 4/2). The corresponding radiation patterns were measured and then plotted, taking into account differences in gain caused by conditions in the ionosphere, at frequencies of 12.3 MHz (summer day) and 15.7 MHz (summer day, summer night, winter day). The radiation pattern of a rhombic antenna was found to almost coincide with that of a rod receiver antenna, each normalized to its maximum intensity. The results indicate the full 8-tier synphasal antenna is the most effective one, while at the lower frequency this antenna and the partial 4-tier one are alternately most effective. The antiphasal antenna is least effective at both frequencies. Figures 4; tables 1; references 4: 2 Russian, 2 Western.
[186-2415]

UDC 621.396.961.06:621.371.11

DYNAMIC MEASUREMENT OF EFFECTIVE SCATTERING AREA OF TARGETS

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 16 Nov 81)
pp 19-22

BESKID, P. P., BUBNOV, A. A. and LEONT'YEV, V. V.

[Abstract] The effective scattering area of a moving target is determined for the general case of foreshortening relative to the radiation pattern of the radar antenna. Calculations involve transformation of the radius-vector of target location from a stationary Cartesian system of coordinates with the origin at the antenna base on earth to a moving Cartesian system of coordinates with the origin on the target. In order to widen the dynamic range of measurements on this basis, it is expedient to attenuate the target displacement signal before the amplifier in proportion to the low-frequency component of the signal modulating process. Such an attenuator with a finite tuning time requires a filter-extrapolator which not only extracts the low-frequency component but also predicts the value of the attenuated signal. This filter can be synthesized assuming a Gaussian acceleration process with uniform spectral density on the $[-\omega_0, \omega_0]$ interval, where ω_0 is the known upper frequency limit, when maximum and mean longitudinal displacement as well as its low-frequency component and maximum normal displacement as well as its high-frequency component are usually also known. A signal reflected from the target passes through the attenuator and amplifier to an analog-to-digital converter, from where it is fed back through the filter-extrapolator and a control device to the attenuator. Figures 4; references 3: 1 Russian, 2 Western (1 in translation).
[186-2415]

UDC 621.314.2.018.782.3.001.24

ANALYSIS OF ELECTROMAGNETIC PROCESSES IN HIGH-VOLTAGE THYRISTOR CONVERTER
DURING CURRENT SWITCHING IN RECTIFIERS

Moscow ELEKTRICHESTVO in Russian No 1, Jan 83 (manuscript received 17 Mar 82)
pp 37-42

GRINSHTEYN, B. I., candidate of technical sciences, ZHMUROV, V. P., engineer,
BEZUGLYY, S. L., engineer, and SIDORSKIY, M. A., engineer

[Abstract] The most effective overvoltage protection of semiconductor-diode rectifiers in a converter are damping RC networks in parallel with them or between converter phases. In the 1960s at the Institute of Power Engineering imeni G. M. Krzhizhanovskiy the use of nonlinear elements, specifically Zener diodes (series-opposing pairs), in such protective networks was proposed and developed. More recently other nonlinear devices have appeared, specifically SN2 varistors, suitable for this purpose. Such protection must be operative under static as well as dynamic and fault conditions. As a basis for optimizing the protection, the electro-magnetic processes in a high-voltage transformer-thyristor converter bridge with RC and varistor protection are analyzed assuming full regulation ($\alpha \approx 90^\circ$). Calculations of the damping factor based on current and voltage relations in the equivalent circuit during and after switching reveal that it is possible, with the use of varistors, to lower the insulation level and decrease the damping capacitance with a resulting decrease of losses. This is particularly significant for converters with lower voltage and higher current rating. It is furthermore possible to reduce size and weight as well as cost of converters without lowering their efficiency. Figures 5; tables 1; references: 4 Russian.

[153-2415]

SIGNAL COMPATIBILITY OF ANALOG AND DIGITAL TRANSMISSION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 10 Feb 81)
pp 20-25

POROKHOV, O. N.

[Abstract] Concurrent transmission of analog and digital signals over symmetric cables is analyzed from the standpoint of compatibility. A specific problem is the detrimental effect of digital signals on analog ones, this effect being manifested in a higher noise level. An illustration of this is operation of a tone-frequency channel with a main digital channel, of the K-60 analog system with pulse-code-modulation IKM-30 or IKM-120 systems in intrazonal networks, and of the KAMA analog system with the IKM-120 system in urban networks. Solutions to the compatibility problem are sought on a theoretical basis and through experimental evaluations, involving selection of optimum signals and suppression of low-frequency spectrum components. A method proposed here is based on the energy characteristics of a linear bipulse signal and its optimal filtration. A system of an IKM-120 channel between two KAMA channels with an intermediate repeater stage and with a terminal repeater at both ends has been developed for transmission along either a common cable pair or two parallel cable pairs. The author thanks Ye. S. Mamonov for formulating the problem and interest in the study, also N. P. Goncharov for assisting in the experiments. Figures 10; tables 2; references 11: 8 Russian, 3 Western.
[172-2415]

COAXIAL TRUNK CABLE FOR FREQUENCIES UP TO 60 MHz

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 83 (manuscript received 12 Jan 82)
pp 9-11

VORONTSOV, A. S., KRESINA, T. A., LEVINOV, K. G., FROLOV, P. A. and
SHAPIRO, R. A.

[Abstract] The frequency range of existing coaxial-pair cables KM-4 and KM-8/6 for communication networks in the USSR extends to 25 MHz, beyond which the attenuation exceeds ITTC recommendation G.623. New coaxial-pair cables KM-4-60 and KMA-4-60 have been developed and designed for production with lead sheath and aluminum sheath, respectively, extending the frequency range to 60 MHz. The outer conductor of a pair is a copper tube made of ribbon stock, the air+thermoplastic insulation system (polyethylene disks 9.2 ± 0.05 mm in diameter and 1.9 ± 0.05 mm thick spaced 32.5 ± 2 mm apart) has an equivalent dielectric permittivity of 1.07-1.084 and a dielectric loss tangent of $(0.20-0.46) \cdot 10^{-4}$. The capacitance of a pair is 46.64 nF/km. The shield consists of two steel ribbons, the outer insulation is two layers of K-12 paper. The

outside diameter of a pair is 11.4 mm, its weight is 198 kg/km. A cable contains four 2.6/9.5 pairs and five symmetric quads with copper core. It will be manufactured in 500 m long segments. The electrical characteristics have been established empirically. The characteristic impedance is 75 ± 0.4 ohms when measured from both ends with a \sin^2 -pulse of 60 ns duration, it increases with higher frequency by an amount inversely proportional to the square root of the frequency. Empirical relations and nominal values are also given for the attenuation coefficient and the phase shift coefficient as functions of frequency. Other characteristics established and conforming with requirements are the velocity of propagating electromagnetic waves, cross-talk attenuation, reflection coefficient at cable input end, and the shielding factor of metal sheaths. Figures 1; tables 2.
[185-2415]

UDC 621.317.7.085.36:621.3.019.4

WEIGHT FUNCTIONS FOR SUPPRESSION OF NETWORK INTERFERENCE IN ANALOG-TO-DIGITAL CONVERTERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 1, Jan 83 pp 59-62

GUTNIKOV, V. S.

[Abstract] Use of special weight functions is an effective method of suppressing periodic interference during analog-to-digital conversion. Here the most conveniently realizable step-curve (piecewise-constant) weight functions are considered for suppression of the fundamental component and then of successively higher harmonics in the interference spectrum. Such weight functions are analyzed by the method of discrete filtration and are synthesized with polynomials. Calculations are based on the amplitude-frequency characteristic of a filter and the characteristic polynomial of a z-transform. Circular polynomials can be used when the ratio of interference period to step width is an integer. Typical results have been obtained for suppression of up to the fifth harmonic from a $(50+1)$ Hz network. Figures 2; tables 1; references 10: 9 Russian, 1 Western.
[158-2415]

UDC 621.321.833

OPTIMIZATION OF CYCLE STRUCTURE FOR DIGITAL TRANSMISSION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 15 Apr 81) pp 28-31

OGANYAN, L. N.

[Abstract] The cycle of information-carrying symbols in asynchronous systems for grouping and separating digital signals is analyzed from the standpoint of its optimization. The number of symbols in a cycle, between two successive

time shifts, depends on the nominal recording frequency f_{m-1} and readout frequency f_m/N_{m-1} (N_{m-1} - number of grouped digital signals) whether matching is unilateral or bilateral. The optimization problem is to establish the length of a cycle for minimum phase jitter caused by asynchronous grouping and separating of digital signals. The problem is solved for known frequencies f_m , f_{m-1} and their instabilities Δf_m , Δf_{m-1} , service data flux, digital errors in the channel, and number of grouped digital signals N_{m-1} ($m \geq 2$) in each stage. The optimization algorithm involves roughly selecting several structural variants, then calculating the utilization factor for the time positions on the basis of a given number of service symbols for speed matching, group synchronization, inspection and control, and ultimately selecting the utilization factor which will ensure both minimum phase jitter and a total number of all symbols that is optimum with respect to cycle synchronization. Figures 2; references 7: 5 Russian, 2 Western. [172-2415]

UDC 621.372.8

MULTIMODE FEEDER FOR 8 GHz RADIO RELAY LINE

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 13 Apr 82) pp 45-48

METRIKIN, A. A. and OSIPOV, Ye. S.

[Abstract] A multimode feeder for antennas of an 8 GHz radio relay lines has been developed. It consists of circular bimetal waveguide tubes. The vertical main feeder segment is 70 mm in diameter and connected to the horizontal antenna terminal waveguide segment, which is 32 mm in diameter, through a diameter reducing transition segment and a bent waveguide tube also 32 mm in diameter. The advantages of a larger feeder diameter are a smaller attenuation coefficient (10 dB/km in waveguide with 70 mm diameter, 4.2 dB/km in waveguide with 32 mm diameter) and thus a lower level of fluctuation noise, as well as larger attenuation of crosstalk between orthogonal modes and smaller cross-polarization coefficient. For the same reasons, a waveguide with circular cross section is preferable to one with a rectangular or elliptical cross section. The segments were matched for minimum reflection coefficients, within 0.028, and the bent tube has a radius of curvature (177 mm) designed to minimize energy transfer from the main H_{11} -mode to the parasitic E_{01} -mode. Its electrical characteristics, including the frequency dependence of the reflection coefficient, were measured with the vector of electric field intensity, respectively, normal and parallel to the plane of bending (horizontal and vertical polarizations). The performance parameters of such an antenna-waveguide channel, including the VSWR and its frequency dependence, were measured in a radio relay line with a long span of 7 km between stations. Figures 7; references 6: 5 Russian, 1 Western. [172-2415]

RECEPTION OF MODULATED RADIATION IN ARRAY-TYPE PHOTORECEIVERS

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 12 Jan 82)
pp 69-71

MERKISHIN, G. V.

[Abstract] Modulation of the light beam intensity tends to reduce the effect of background illumination in optical receivers. Here the effectiveness of this method is evaluated for an array-type photoreceiver, taking into account that individual cells of the array are switched to the common-channel output sequentially and the signal is integrated during the frame period between successive interrogations. The power of incident modulated radiation consists of a constant component and a cosinusoidally alternating one, the output signal of each photosensitive cell being a charge packet. Calculations are made assuming that the phase of the alternating component is known and that the modulation frequency is sufficiently low relative to the rate of array interrogation. The condition for maximum ratio of the alternating component to the noise charge is established on this basis and the signal-to-noise ratio is calculated accordingly. The optimum interrogation interval is obtained by differentiating the signal-to-noise ratio with respect to the interrogation period for one cell and equating the derivative to zero. It is found to be equal to half the modulation period. Results obtained with typical parameters of array-type photoreceivers confirm the high effectiveness of this method in increasing the sensitivity of such photoreceivers. Figures 1; references 2: 1 Russian, 1 Western (in translation).
[186-2415]

UDC 621.383.9:535.854

ASYMPTOTIC RECEPTION OF OPTICAL SIGNALS UNDER INDETERMINACY CONDITIONS

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 10 Mar 82)
pp 71-73

TOLPAREV, R. G., POLYAKOV, V. A. and BORISOV, E. V.

[Abstract] Reception of optical signals is considered in the case of unknown a priori information about the distribution parameters of noise and the signal+noise mixture. Conventional adaptive reception is now always feasible, when not all the missing information becomes available in time. It also requires direct measurement of parameters and thus complicates the receiver structure. A method is proposed which assumes a known a priori probability of "unity" transmission and uses the a posteriori probability of "unity" transmission as the measurable parameter. The difference between the two probabilities serves as the receiver performance characteristic and a zero difference between them is the optimality criterion for the resolver threshold. This adaptive algorithm

is more efficient than one with a fixed resolver threshold, but is not optimal in the case of completely known a priori information. An evaluation of its efficiency with incomplete and complete a priori information shows it to be an asymptotically optimal one. Figures 2; references: 3 Russian.
[186-2415]

UDC 621.391.82

INTERFERENCE IMMUNITY OF RADIO INTERFERENCE COMPENSATORS FOR FM COMMUNICATION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 (manuscript received 12 Oct 81)
pp 42-48

BYKHOVSKIY, M. A.

[Abstract] Two radio interference compensators are considered for FM communication systems in connection with the problem of electromagnetic compatibility. Because an optimum two-channel compensator is too complex, an optimum single-channel one and a suboptimum two-channel one are considered instead. Their performance is analyzed jointly, assuming the connection between channels on the input side to be open for two-channel operation and closed for single-channel operation. The phase detector in the synchronous-phase demodulator is followed by a filter: an integrating one, a double integrating one, or an optimum Wiener filter. Calculation of interference and noise immunity characteristics, with optimized compensator parameters in each case, indicate that the suboptimum two-channel compensator approaches the optimum two-channel one under conditions prevalent in radio relay lines and in FM systems with orthogonally polarized radio waves. Threshold and stability characteristics have not been taken into account in this evaluation. The author thanks V. V. Shakhgil'dyan for helpful comments. Figures 5; references 10: 8 Russian, 2 Western.
[113-2415]

UDC 621.391.833

COMPUTER-AIDED DESIGN OF LINE SEGMENT FOR DIGITAL TRANSMISSION SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 30 Jan 80)
pp 26-28

GRIDNEV, S. A.

[Abstract] A line segment of a digital transmission system, namely a repeater stage, is designed on the basis of its analog model consisting of a cable segment and a corrective amplifier followed by a resolver. The procedure involves determining the pulse and the mean thermal noise at the resolver

output when the pulse at the cable input as well as the amplifier characteristics and the transfer functions of cable and amplifier are known. The object is to ensure adequate interference immunity of the repeater. Calculations involve performing discrete Fourier transformations and approximating the frequency characteristics of the cable, standard expressions being used for the frequency dependence of the attenuation coefficient and the phase shift. These calculations have been programmed for a computer so as to ensure high speed and accuracy. The design of a 3 km long repeater segment with a KMB-4 coaxial cable for a quadded 139/264 Mbit/s digital transmission system serves as an illustration. Figures 4; references 7: 3 Russian, 4 Western (1 in translation). [174-2415]

UDC 621.394.085.33

DEVELOPMENT OF FIBEROPTIC SYSTEMS FOR DATA TRANSMISSION

Moscow ELEKTRICHESTVO in Russian No 1, Jan 83 (manuscript received 3 Jan 82)
pp 4-11

GRODNEV, I. I. and LAVROV, V. M. [deceased]

[Abstract] Optical cables, in addition to being made of glass and plastic materials rather than of scarce metals, offer several other advantages over electrical communication cables: wide transmission band and large transmission capacity, small attenuation independent of frequency over a wide range, high immunity to electromagnetic interference, small size and weight, and suitability for underground installation. Development of optical fibers for data transmission has largely been stimulated by the appearance of lasers, especially solid-state semiconductor lasers of the pn-diode type. A fiber cable transmits an electric frequency or time signal which modulates the optical carrier frequency or intensity. Digital transmission is the general rule, inasmuch as analog transmission requires a high linearity of intermediate amplifiers which is difficult to attain. Most widely accepted is digital transmission with pulse code modulation and with time division of channels, a laser or light-emitting diode serving as a transmitter, as well as an electro-optic converter and a photodiode serving as a receiver. Special-purpose analog data transmission is also effected by pulse modulation. The operating frequency ranges extend to 10^5 Hz for overhead lines, 10^6 Hz for symmetric cables, 10^9 Hz for coaxial cables. Waveguides are used in the millimetric wave band (10^{10} - 10^{11} Hz) and light guides are used in the visible range (10^{14} - 10^{15} Hz). The physical processes involved in transmission through a light guide, along a glass core inside a dielectric shell, are multiple reflection and superposition of surface waves (dielectric permittivity of core $\epsilon_c > \epsilon_s$, dielectric permittivity of shell, incidence angle $\theta_1 > \theta_c$ * critical angle). Design and performance of fiber cables are based on this principle, losses and attenuation determining the distance between successive repeater stages. Scattering by inhomogeneities smaller than the wavelength and due to thermal fluctuations of the refractive index is essentially a Rayleigh process proportional to the fourth power of

frequency. Radiative losses are caused by bends and twists. The technology of optical cables must take these factors into account, in order to ensure minimum energy loss and signal distortion. The main types of construction are twisted fiber strands, helical fiber strands, and flat lay of fiber strands in stacked ribbons. Hookup is the most critical operation, the main requirements being stability of contact and resistance to external influences, and alignment being essential for minimizing transition losses. Hookup is made with splices (electric-arc welding), connecting sleeves, or split connectors. Among the latest achievements in fiberoptic communication systems are transmission lines operating at rates of 34-140 Mbit/s, the cost per channel-km being lower than that of electrical cables and also decreasing linearly with increasing number of channels, development of gradiental fibers with an attenuation of only 0.5 dB/km at the 1.6 mm wavelength, and installation of long-distance (transoceanic) transmission cables. Figures 8; references 11: 8 Russian, 3 Western (in translation). [153-2415]

UDC 621.395.4:621.317.6

INTERFERENCES IMMUNITY OF LENGTHENED LINE SEGMENT BETWEEN ATTENDED REPEATER STATIONS IN VLT-1920 TRANSMISSION SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received 26 Nov 80)
pp 32-35

ROMBRO, V. S. and SHKOL'NIKOV, M. B.

[Abstract] In the VLT-1920 transmission system, developed in the GDR according to specifications of the USSR Ministry of Communications, the maximum distance between neighboring feed points is 186 km and all unattended repeaters of a two-way line segment are fed from two remote power supplies, one for each direction of transmission. The performance of line segments, with automatic gain control was evaluated at the Moscow Institute of Economics and Statistics and found to be satisfactory so as not to require a redesign of the automatic gain control for line segments lengthened by elimination of attended repeater stations. The load curves were adjusted accordingly, during winter and within periods of minimum rate of temperature change. The amplitude-frequency characteristics of longer line segments were corrected by means of a pre-corrector on the transmitter side, in addition to a Syst.Ez B1140 system equalizer and Ma.Ez Eb540 trunk equalizer on the receiver side included in the VLT-1920 equipment. The interference immunity of line segments was measured under a full load consisting of white noise only and with the two ways of transmission connected into one loop. The results reveal a beneficial effect of precorrection and indicate a high degree of interference immunity to be expected under actual operating conditions. Figures 6; references: 5 Russian. [172-2415]

DETERMINING OPTIMUM PULSE RESPONSE CHARACTERISTIC OF LINEAR CORRECTIVE CIRCUIT IN OPTICAL RECEIVER

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received after completion, 7 May 82) pp 73-75

ZELIGER, A. N.

[Abstract] A receiver of digital optical signals is considered which consists of a photodetector with wideband load, a wideband amplifier, a linear filter, a sampling device and a threshold device. The pulse response characteristic of the filter and the threshold voltage for the threshold device are to be optimized in order to ensure the minimum total probability of error. The electric signal at the amplifier input is assumed to have two components: realization of a nonstationary quantum random process $X(t)$ and realization of a stationary random process with zero mathematical expectation, the $X(t)$ process being replaceable by a mathematical expectation and a centered random process. Processes $X(t)$ and $R(t)$ can both be regarded as "white". The voltage at the amplifier output is assumed to have a normal distribution at the end of a sampling period. The pulse response characteristic calculated on this basis differs from that of a conventional matching filter by having an additional term in the denominator accounting for quantum noise. Figures 1; references 7: 6 Russian, 1 Western (in translation).
[186-2415]

EQUIPMENT FOR CHECKING ACCURACY OF SYNCHRONIZATION OF RADIO STATIONS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 (manuscript received 16 Jun 81) pp 38-40

ZYBIN, Ye. I.

[Abstract] Radio transmitters are phase synchronized during the day, for optimum operation, and phase or frequency synchronized during the night. Equipment for checking the accuracy of synchronization checks the deviation from nominal of the carrier frequency at a local station. It generates sound and light alarm signals when this deviation exceeds the permissible limits according to norms of the State Commission on Radio Frequencies: 0.01 Hz for long-wave and 0.05 Hz for short-wave transmission. The equipment operates automatically and continuously. It consists of a receiver of reference (standard) frequency and a number of frequency measuring modules equal to the number local stations. The receiver of reference frequency, with a frame antenna, power supply and automatic control, includes a phase detector, a simple-frequency synthesizer generating 66, (6); 155, or 200 kHz and another frequency synthesizer with 1 kHz steps, the latter controlled by a quartz oscillator. A measuring module consists

of input and output stages of a radio broadcasting receiver with frame antenna, a phase meter and a frequency synthesizer, also automatic control and power supply. The equipment is built with standard components for 155-281 kHz long-wave radio stations and 531-1602 kHz short-wave radio stations, using analog and digital microcircuits (series 226 in the reference-frequency receiver, series 140 in the broadcasting-frequency receiver, series 155 in frequency synthesizers and phase detectors, series 142 in voltage stabilizers). Figures 2; tables 1; references: 4 Russian. [113-2415]

UDC 778.534.48-52

AUTOMATIC DIGITAL SYNCHRONIZER

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 83 pp 57-62

BELAN, S. V.

[Abstract] An automatic digital synchronizer has been developed and built for synchronizing any 8-mm movie projector and "stereo" magnetic sound recorder. Its operation is based on counting pulses, comparing their number, and forming an appropriate control signal. Its main component is a reversible counter. Pulses from projector and recorder are not applied to the counter directly so as to avoid their possible coincidence in time and appearance at both inputs, which would be incompatible with the particular mode of operation. Auxiliary devices preventing this include a set of switches and an adjustable resistor, as well as a high-frequency oscillator, a film position indicator (already available in the movie projector) and a recorder signal amplifier-limiter. A manual corrector consisting of two buttons and two triggers with a microcircuit assembly produces additional pulses for the counter as necessary. The equipment contains also a distributor and a power supply, the latter with voltage adjuster and stabilizer. The synchronizer is assembled on two boards, one containing the analog-digital part and the other mounted directly inside the movie projector carrying an optron, a thyristor, and two diode bridges. The synchronizer is very accurate, it has high immunity to interference and a wide locking range (512 frames, 28 s). Its present 4.5 Hz repetition rate of synchronizing pulses could be raised to 18 Hz. Other functional features can also be added in order to improve the overall performance, particularly in the areas of regulation and automation. Figures 5; references: 3 Russian. [189-2415]

TELEVISION SETS 1983

Moscow RADIO in Russian No 1, Jan 83 pp 25-27

BOROVKOV, N., Moscow

[Abstract] Television sets which will be available on the market in 1983 include 28 color models and 7 black-and-white models, built-in and portable. Their main features such as screen size and program selection along with their technical characteristics (power consumption, range of wavelengths, voltage sensitivity, audio output power, sound-track frequency range), as well as size, weight, and price are tabulated for convenient comparative evaluation. The models include continuation of earlier ones, new ones, and solid-state integrated-circuit versions of older ones. Figures 1; tables 1.
[170-2415]

CABLES WITH ALUMINUM-ALLOY AND COPPER-ALUMINUM CORES FOR RURAL TELEPHONE NETWORKS

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 p 60

KOVALEVA, I., Science and Engineering Council to USSR Ministry of Communications

[Abstract] Cables with copper-aluminum cores and hydrophobic filler have been experimentally installed in rural telephone lines and wire broadcasting lines. Pilot operation has revealed that subscriber cables TSPZPb 5x2x0.9 and BKSPZP 1x4x1.2 are sufficiently reliable and their electrical characteristics remain stable. Subscriber cables TSPZPb 10x2x0.5 as well as trunk feeder cables MRMPb 2x1.2, MRMPEb 2x1.2 and distribution feeder cables PRPIIb 2x1.45 are structurally deficient and subject to corrosion after the sheath has been damaged. Recommendations have been developed on the basis of this experience pertaining to cable selection and installation. The study of such cables is to extend to urban telephone and long-distance communication lines.
[172-2415]

UDC 621.39:621.376.56

INTEGRATED DIGITAL NETWORK FOR MANAGEMENT OF MUNICIPAL ECONOMY

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 (manuscript received 15 Nov 80)
pp 29-31

SMIRNOV, S. N., FEDOTOV, V. I. and DIVNOGORTSEV, G. P.

[Abstract] A network is being planned and developed for integrating the control of all communication systems in a municipality such as Moscow. The network must be universal, for all modes of communication (telephone, telegraph, television, facsimile, discrete data), with a transmission capacity of up to 30 kbits/s and an error factor not exceeding 10^{-6} . It must facilitate information exchange between any subscribers, also in conference and general circulation modes, must ensure privacy (if necessary) and allow for prioritization. Replacement of terminal subscriber and station equipment must be possible without interruption of service. Only an integrated digital communication system with electronic automatic switching meets all these requirements. Existing urban telephone cables can be utilized most economically for this network if multiplexed with delta-modulation codes by means of the necessary IKM-30 pulse-code-modulation equipment. Up to 56-60 subscriber channels with 32 kbits/s capacity each can in various ways be merged into a single 2048 kbits/s trunkline, which is then split again into up to 56-60 individual channels in the switching station. Both through-call and terminal electronic automatic switching stations are available. Figures 2; references: 7 Russian.
[113-2415]

UDC 6]1.316.726.078

FILTERING CHARACTERISTICS OF PHASE-LOCK AUTOMATIC FREQUENCY CONTROL SYSTEM FOR YIG-OSCILLATOR

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 (manuscript received 23 Jun 81)
pp 51-54

ALEKHIN, Yu. I., KARYAKIN, V. L. and PROKOF'YEV, V. S.

[Abstract] A phase-lock automatic frequency control system for a YIG oscillator is considered which operates at harmonics of the reference signal. A stroboscopic phase detector is followed by a d.c. amplifier and the latter by

a control element across the oscillator, with the oscillator output fed back to the phase detector. The fundamental equation and the transfer function of such a system with stiff power supply are derived on the basis of this model. The phase-lock system constitutes a low-pass filter for phase noise in the reference oscillator and a high-pass filter for noise in the controlled oscillator. The frequency which couples both filters, i.e., their amplitude-frequency characteristics is determined by the time constant of the oscillatory component of the control system, being equal to the reciprocal of that time constant. The optimum time constant (coupling frequency), which will minimize the dispersion of the amplitude-frequency characteristic of the phase-lock system caused by external and internal noise, is calculated for an ideally noninductive d.c. amplifier. Initial frequency deviations in a real system are reduced and the locking band widened by insertion of a corrective device, a proportionally integrating filter being considered here and found to be very effective. Figures 2; references 6: 4 Russian, 2 Western.
[113-2415]

UDC 621.372.54

APPLICATION OF FREQUENCY CONVERSION METHOD TO SYNTHESIS OF DIGITAL FILTERS

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received after completion, 21 Jun 82) pp 34-36

LABUTIN, V. K. and CHECHULIN, V. N.

[Abstract] Synthesis of digital filters by the frequency conversion method is considered for the design of a digital high-pass, band-pass or band-elimination filter with given corner frequencies on the basis of an "existing" digital low-pass filter with arbitrary corner frequency. When the cutoff frequencies of the stop bands (width of crosstalk attenuation) have also been stipulated for the new filter, then the relations between these cutoff frequencies and those of the "existing" filter must be established. An analysis of the conversion formulas for synthesis of a digital band-pass filter, as an example, reveals that in this case it is sufficient to select an "existing" digital low-pass filter with arbitrary corner frequency and a definite stop-band cutoff frequency only. The corner frequency of the "existing" filter can be arbitrary, indeed, because the filter can always be converted to another one with a priori stipulated corner frequency. Figures 1; tables 1; references 6: 2 Russian, 4 Western (2 in translation).
[186-2415]

COMPARATIVE EVALUATION OF FOUR ALGORITHMS OF ADAPTIVE PREDICTION FOR DIFFERENTIAL PULSE CODE MODULATION

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 9 Feb 82)
pp 44-46

SITNYAKOVSKIY, I. V., NEKHAYEV, A. L. and IVANOV, A. V.

[Abstract] Speech encoding by differential pulse-code-modulation with adaptive prediction ensures a sufficiently high fidelity at transmission rates below 16 kbit/s. The encoder structure consists of an adaptive predictor Q and a second-order linear filter $P(z) = b_1 z^{-1} + b_2 z^{-2}$. The "classical (A_1) of adaptive prediction, based on the autocorrelation method, requires a delay line for input readouts and an additional channel for transmitting the prediction parameters b_1 , b_2 and the quantization step o to the decoder. Assuming a nearly Gaussian distribution of readouts results in a simpler algorithm (A_2). Both a delay line and an additional transmission channel can be eliminated by determining all three parameters for only one instant of time, from preceding restored readouts. This can be done so as to simplify algorithm A_1 directly (algorithm A_1') or indirectly (algorithm A_2') by simplification of algorithm A_2 . A comparison of all four algorithms, based on a computer simulation of several test sentences, indicates that, according to a quality criterion which characterizes their efficiency, algorithms A_2, A_2' are correspondingly almost as good as algorithms A_1, A_1' but easier realizable and that algorithms A_1', A_2' are somewhat but not very significantly worse than algorithms A_1, A_2 . The author thanks V. A. Pertseva for assisting with simulation of the systems. Figures 2; references 5: 2 Russian, 3 Western.
[186-2415]

OPTIMAL READOUT PROCESSING OF SIGNALS SUBMERGED IN BACKGROUND INTERFERENCE WITH ARBITRARY DISTRIBUTION

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received 17 Jan 82)
pp 40-44

ZHODZISHSKIY, M. I.

[Abstract] Randomized binary quantization is considered in the case of an input signal appearing with background interference which has an arbitrary unknown bounded distribution. The optimum decision function $D^*(y)$ is determined from one readout ($L = 1$), the problem being approached from the standpoint of the theory of games. The payoff function is calculated after the range of possible values of y has been subdivided into intervals. The optimum algorithm of determining the signal polarity can be realized in two forms, either with

$D^*(y)$ calculation and a $\mu = \begin{vmatrix} +1 \\ -1 \end{vmatrix}$ decision in sequence or with a random signal added to the readout. Under certain conditions both forms become equivalent and not distinguishable. Moreover, for every optimum algorithm in the first form there can be found an equivalent game algorithm in the second form ensuring the same cost (for every game algorithm in the first form a completely equivalent algorithm in the second form cannot be found). These concepts, first based on assuming an invariable information carrier, are subsequently applied to the case of an optimally variable information carrier. The cost of the game is calculated, taking intrinsic noise into account. A game-type receiver is synthesized for optimal readout processing, which executes a randomized algorithm or a deterministic algorithm depending on whether or not the power of the artificially added interference exceeds the power of intrinsic noise. Figures 3; references 4: 3 Russian, 1 Western (in translation). [186-2415]

IMPROVING OPERATION OF TRANSMISSION CHANNELS AND LINES

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 83 p 37

[Abstract] A traditional seminar-conference was held in September 1982 at Kiev on technical servicing and operational control of the primary trunk network. The seminar was organized by the UkSSR "Znaniye" society and its Publishing House for Dissemination of Economic and Scientific-Technical Information, republic-wide and Kiev city boards of the Scientific-Technical Society of Radio Engineering, Electronics and Communication imeni A. S. Popov, and the Kiev branch of the Central Scientific Research Institute of Communication. Also participating were UkSSR ministries and territorial management centers for interurban communication and television transmission as well as various higher educational institutions, scientific research and design institutes, and communication enterprises from throughout the USSR. The subject of over 20 presentations with both theoretical and practical content was automation of the lowest-level link in the primary network with necessary equipment, processing, control, and maintenance. Progress in automation of the operational-technical network management, including the technical maintenance, recommended by earlier such conferences (1975-81) was reported and recommendations with regard to further activities in this area were adopted. [185-2415]

COMMUNICATIONS

UDC 621.39

EXPERIENCE WITH DATA TRANSMISSION IN AUTOMATIC CONTROL SYSTEM OF GORKIY AGRICULTURAL EQUIPMENT ASSOCIATION

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 (manuscript received 27 Jun 79)
pp 32-33

TRETYAK, G. B., NOVIKOV, V. B., USHAKOV, E. S. and SHKAPINA, N. A.

[Abstract] The automatic control system of the Gorkiy "Sel'khoztekhnika" (Agricultural Equipment) association transmits and processes data on location and movement of goods throughout the region covered. The system includes an information-computation center in Gorkiy and 12 primary data processing stations at interdistrict bases. It uses the public telephone network extensively, which facilitates data transmission with an error factor not exceeding 10^{-6} . However, the otherwise very adequate "Akkord-1200" equipment has been found to be unsatisfactory for the Gorkiy region which has rather low-quality telephone channels and "Sbor-1200" equipment has been installed instead. Data transmission occurs twice daily: in the morning from the 12 field stations to the center, for processing on the "Minsk-22" computer and in the evening from the center back to the field stations. Transmission over the communication channels occurs at rates of 1200 and 600 baud (140 and 70 symbols/s in ITC code, 80 and 40 symbols/s in GOST 13052-74 code). Both personnel and equipment have been organized for reliable and efficient service, including inspection, maintenance and repair. The data transmission system functions best when it is centralized, electromechanical input-output devices being the main source of errors in the information received.

[113-2415]

UDC 621.3.066.6[669.22+669.735]:621.77

ELECTRIC CONTACTS MADE OF Ag-CdO COMPOSITE AND PRODUCED BY ROLLING PROCESS

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 83 (manuscript received 14 Apr 82)
pp 49-50

AL'TMAN, A. B., doctor of technical sciences, professor, MELASHENKO, I. P.,
candidate of technical sciences, BYSTROVA, E. S., candidate of technical
sciences, KOSARIMOV, Ye. N., candidate of technical sciences, BROVMAN, V. G.,
engineer, PEREGUDOVA, T. V., engineer, KUZNETSOV, V. I., engineer, and
OREKHOV, A. V., engineer

[Abstract] Low-voltage electric contacts made of the 85% Ag+ 15% CdO composite do not need to be thicker than 1 mm, but cannot be reliably produced with such small dimensions by conventional methods of powder metallurgy. They can be produced precisely from rolled stock by stamping or cutting. Two variants of this technology were studied. In the first method slabs produced from fine-disperse CdO powder with a sublayer of silver powder by pressing and sintering were rolled down in steps with annealing before each pass. In the second method stacks of cold welded different metals with compatible deformability, namely 86-14 Ag-Cd alloy and 99.9% pure silver were either hot or cold rolled in steps with intermediate annealing, then subjected to internal oxidation through diffusion by heating in air. Specimens of 0.8 mm thickness produced by both methods were examined metallographically and tested for hardness, electrical resistivity, and for wear under operating conditions (in PAE-300 magnetic starter at $I_{ON} = 240$ A - $V_{ON} = 380$ V, $I_{OFF} =$ A - $V_{OFF} = 65$ V, $\cos \psi = 0.3$, 500,000 cycles at 600 cycles/h). Their characteristics were found to be better than those of conventional contacts. Therefore, it appears feasible to economize silver by producing electric contacts from rolled cement slabs or rolled bimetal stacks, the latter internally oxidized. Tables 3; references: 5 Russian.
[152-2415]

COMPUTERS

UDC 621.314.26

OPTIMIZATION OF ENERGY RELATIONS IN THREE-STAGE FERRITE-TYPE FREQUENCY MULTIPLIERS WITH AID OF DIGITAL COMPUTER

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received after completion, 7 Jan 82) pp 32-36

BOGACHENKOV, A. N., BOCHAROV, M. I. and NOVOZHILOV, O. P.

[Abstract] The energy characteristics of frequency multipliers are improved by insertion of an idle loop tuned to some intermediate frequency between the input and output stages. Performance optimization with the account losses in the intermediate stage taken into account involves determining the energy relations in the nonlinear (ferrite-core) element which will ensure maximum efficiency and output power. Several variants of a three-stage multiplier are considered, with a transformer or a choke as the nonlinear element. A method of solving the optimization problem is shown based on a square-loop characteristic of the ferromagnetic material and ideal filters in all three stages, with the assumption that maximum power and efficiency correspond to the maximum power converted by the nonlinear element. An algorithm of calculations on a digital computer is constructed which yields the optimum circuit parameters. The procedure and results are shown for a frequency multiplier with an input stage and intermediate stage coupled through a choke, in the case where the power requirement and the amplitude of the input signal as well as the maximum magnetic induction in the choke core have been stipulated. Figures 2; tables 1; references: 2 Russian.
[123-2415]

UDC 621.373:681.32

DIGITAL COMPUTING SYNTHESIZERS OF BINARY SIGNALS WITH COMPENSATION OF PHASE ERRORS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 21 Jan 82) pp 15-19

KOCHEMASOV, V. N. and FADEYEV, A. N.

[Abstract] Digital computing synthesizers of binary signals for microprocessors are considered which feature short transient periods (only a few clock periods) and a large number of synthesizable frequencies f_s with fine tuning (10^{-6} steps).

Those without digital-to-analog converters contain a code accumulator where synthesizable oscillations of quasi-meander waveform are generated through overflow pulse sequences. Required spectral characteristics are usually attainable by successive frequency halving, each division yielding a gain of 6 dB. It is also possible to improve the spectral characteristics without a large divisor and thus without narrowing the range of synthesizable frequencies. Such a synthesizer consists of a time base generator, a storage of modulo-N codes, a control unit, a delay line, and a divider of pulse repetition rate with quotient n. The clock frequency f_c and the number of taps on the discrete delay line $M = 2^L$ (L - number of digits in delay code) are calculated which will ensure compensation of phase errors. As L is increased (L = 0 corresponds to no compensation), the odd harmonics of the synthesized oscillation become more meander-like and the distribution of nonharmonic components becomes more regular and also more symmetric relative to those odd harmonics. As a result, the noise level decreases, but so does the speed of the code divider while its complexity increases. The control unit must, therefore, be designed so as to ensure that $|\Delta K_f/K_{f0}| \leq 2^{-L}$ (frequency code $K_f = nNf_s/f_c = K_{f0} + \Delta K_f$, $K_{f0} = 2^{-qN} \leq K_f$, $q = 0, 1, 2, \dots$), $p = 1, 2$ being of practical interest and $p = 1$ particularly expedient. Figures 4; references 4: 2 Russian, 2 Western (1 in translation).
[123-2415]

UDC 621.391.82:681.142-523.8:621.316.925.2

IMPROVING INTERFERENCE IMMUNITY OF MICROCOMPUTERS USED IN RELAY PROTECTION DEVICES

Moscow ELEKTRICHESTVO in Russian No 12, Dec 82 (manuscript received 25 Dec 81)
pp 54-55

LESIN, N. M., engineer, and FAYBISOVICH, V. A., candidate of technical sciences, BSSR, Minsk

[Abstract] The microcomputers used in modern relay protection devices are subjected to considerable interference generated by power plants and substations. Because of the complexities of developing means of interference protection on the actual devices, considerable attention has been given to interference simulators that can reproduce the main types of interference characteristic of energy-producing facilities. The authors describe two such simulators: a simulator of pulsed interference and a simulator of high-frequency interference. The pulse interference simulator is a generator of standard 1.2/50 μ s pulses with controllable amplitude of up to 5 kV. The working principle of this facility is based on periodic discharge of a capacitor across a calibrated resistor at the instant of breakdown of an air spark gap. The exponential pulse from the calibrated resistor is the output. A variable resistor controls the pulse recurrence rate. Voltage amplitude is controlled by an autotransformer and variation of the spark gap. The high-frequency interference simulator generates damped waveforms with an envelope that falls to 50% of the initial peak amplitude after 3-6 periods of the oscillations. Frequency is $1 \text{ MHz} \pm 10\%$,

Frequency is $1\text{ MHz} \pm 10\%$, amplitude is $500\text{--}2500\text{ V} \pm 10\%$, recurrence rate of pulse bursts is $390\text{ Hz} \pm 10\%$. These simulators were used to study the interference immunity of "Elektronika S5" microcomputers. Interference filters are designed on the basis of the results. Figures 5; references 8: 6 Russian, 2 Western. [181-6610]

DESIGN AND PERFORMANCE OF INTEGRAL MAGNETIC HEADS

Moscow RADIOTEKHNICA in Russian No 10, Oct 82 (manuscript received after completion 28 Dec 81) pp 26-28

KRINTSIK, G. S., SHAMATOV, U. N., KHALETSKIY, M. B., SUKHAREV, M. P. and FILATOV, O. I.

[Abstract] Design data on integral magnetic heads are presented which pertain to the solid-state structure rather than to the air gap. Theoretical calculations were based on the Biot-Savart-Laplace law in the two-dimensional formulation for a structure consisting of magnetic, insulating, and conducting layers built up on a substrate. Experimental data were obtained by magneto-optical measurements based on the Kerr effect. The results indicate that integral magnetic heads with large interconductor distances are not economical in the recording mode. Figures 3; references 3: 2 Russian, 1 Western.
[123-2415]

UDC 621.397.612:681.325.5-181.4

DIAGNOSTICS OF MICROPROCESSOR SYSTEMS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 83 pp 37-44

YEFREMOV, V. Ya., Television Technical Center imeni 50-letiya Oktyabrya

[Abstract] Microprocessors as the base of microcomputers were introduced into television broadcasting centers in 1979. The MP 8080, especially interfaced with two microcomputers, controls audio switching arrays. Such a microprocessor must be tested diagnostically for faults and malfunctions. There are several problems associated with trouble-shooting in such a system. One problem arises from the fact that much functional hardware has been replaced with functional software stored as microprograms in the read-only computer memory. Another problem arises from the high degree of dynamicity of operation, with pulse signals of microsecond duration, so that it becomes necessary to know not only where but also when to test. Bidirectionality of the processor busbars makes interpretation of addresses and data difficult, especially with many loads connected in parallel according to the OR scheme. The test equipment must, furthermore, be capable of tracking many elementary operations, because the number of steps in processor programs for new measuring instruments and procedures has been increased from hundreds to thousands. Three methods designed to cope with these problems are available. The first is based on the principle of "built in" self-diagnosing, with special test programs for trouble-shooting functional system components and memory elements. The second method is signature analysis, using HP 5004A equipment, by means of compression of complex information and subsequent conversion to a uniquely characterizing simple one, wither automatically or by programmatic control. The third is by displaying addresses in the form of dynamic charts on the screen of a cathode-ray oscilloscope. A typical test program for checking the read-only memory illustrates these principles of using the microprocessor for checking the entire system based on it. Figures 8; tables 2; references: 5 Russian. [189-2415]

NEW HIGH-SPEED INJECTION AND FIELD-EFFECT THYRISTOR POWER SWITCH

Leningrad PIS'MA V ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 9, No 1,
12 Jan 83 (manuscript received 20 Oct 82) pp 18-21

GREKHOV, I. V., GORBATYUK, A. V., KOSTINA, L. S., MUKOVNIKOV, K. V. and
SMIRNOVA, I. A., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy
of Sciences, Leningrad

[Abstract] A thyristor power switch is described which combines high speed of a field-effect device with the technological advantages, namely easier fabrication and better utilization of wafer surface, of a plain device. It is essentially a high-voltage thyristor with a structure consisting of wide n^+ -emitter strips in a p_1^+ -region, an n-base under the p_1^+ -region with narrow n-channels through the latter connecting the n^+ -emitter strips to that n-base, and a p_2^+ -region under the n-base. The n^+p -junction has a low breakdown voltage and, consequently, doping the narrow p_1 -strips between n^+ -strips with an acceptor impurity provides a built-in opposing field and thus improves the cutoff characteristics. A reverse bias across the n^+p -junction blocks a forward bias between n^+ -emitter and p_2^+ -collector. The device features an almost zero turn-on delay: a control current pulse recharges the barrier capacitance of the gate and turns the channel on, whereupon the current first rises fast (within 80 ns) to a $2 \cdot 10^3$ A/cm² level and then continues to rise slowly. For optimum performance, the load impedance should be higher than the total impedance of channels at the end of the first stage of current buildup. The turn-on time is 50 ns and the stabilization time is 4 microsecond. Figures 2; references 7: 4 Russian, 3 Western.
[173-2415]

INSTRUMENTATION & MEASUREMENTS

UDC 62-408.8:519.2:535.001.14

DETERMINATION OF CORRELATION FUNCTION FOR HEIGHT OF ASPERITIES ON POLISHED METAL SURFACES BY REFLECTOMETRIC METHOD

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 83 pp 17-20

OBRADOVICH, K. A. and POPOV, Yu. N.

[Abstract] Two reflectometric methods of determining the correlation function are considered for measurement of the roughness of polished surfaces. They are based on the scattering indicatrix with the reflection coefficient as a function of the scattering (observation) angle for a constant incidence angle, this indicatrix being independent of the absolute reflection coefficient and of the small solid angle containing a light beam reflected in any given direction. An evaluation of this indicatrix involves integration of the product of a zero-order Bessel function by the correlation function for the heights of surface asperities. The correlation function can be approximately established by either of two methods. In the first method it is assigned various values, the integral evaluated each time, and the scattering indicatrix calculated. This theoretical indicatrix is then compared with an experimental one obtained by measurements and a function approximating the correlation function is selected accordingly. In the second method the correlation function is evaluated by numerical analysis and approximated on that basis. Several such functions have been tested analytically and experimentally, among them a Gaussian and a simple exponential one, for accurate determination of the correlation interval and radius as the two roughness parameters. For polished copper surfaces in a typical laser light (He-Ne laser with wavelength $\lambda = 0.6328$ micrometer) and a scattering indicatrix between 6° and 70° from the normal to the surface best results have been obtained with a Lorentz function $K(\tau) = \sigma^2 / (1 + \sigma_1^2 \tau^2)$. Figures 4; references 7: 2 Russian, 5 Western.
[187-2415]

EXPERIENCE WITH USE OF COMPUTER IN METROLOGICAL SERVICE OF ENTERPRISES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 83 pp 9-10

MEDNIKOV, Yu. A., IGNAT'YEV, V. V., NIASOV, A. A. and MATVEYEV, V. P.

[Abstract] Automatic quality assurance with the aid of a metrological subsystem for production control was introduced in 1980 into the Chelyabinsk "Order of Lenin" pipe rolling plant. Its base is a YeS 1022 Unified System computer and a data bank, both a part of the powerful information system "Pribory" (Instrument) installed at the plant's Central Measurements Laboratory. The structure and the volume of data for operation of this system have been carefully designed and optimized to meet the requirements of such a special-purpose application. The system serves as a powerful aid to the technical and economical management of all the plant's measuring equipment, which includes planning and scheduling of its use, checking and calibration, maintenance and repair, preventive inspection and replacement. Documentation and display of information facilitate continuous and permanent control of all operations which involve all the available instruments and appurtenances. Further studies are being conducted jointly by the Central Measurements Laboratory and the Department of Automatic Production Control on fuller utilization of the computer capacity for a broader range and a higher level of problem solving. References: 3 Russian.
[187-2415]

UDC 620.1+621.3.019.3

MEASURING INSTRUMENT FOR SWITCHING-PERFORMANCE TESTS OF HIGH-VOLTAGE ALTERNATING-CURRENT CIRCUIT BREAKERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 83 pp 38-40

KUROCHKIN, V. I.

[Abstract] At present standard testing and measuring equipment, especially intended for investigation of process taking place in high-voltage apparatus is not produced. Consequently, an instrument for measuring electrical and non-electrical magnitudes has been built and installed in the test stand at the Scientific Research Institute of "Uralelektrotyazhmash" (Ural Heavy Electric Machinery) Industrial Association for testing high-voltage a.c. circuit breakers in accordance with GOVERNMENT STANDARD 687-78 requirements. Its main components are five current transformers (TNSH 25000/5 Class 0.5 accuracy, TLSh 72000/5 Class 0.5 accuracy, TPSHF 35 kV pri. nom., TFN 35 kV pri. nom., VTT air-core for di/dt measurement), two potential transformers (NOM-35 kV, NOM-110 kV), one 35kV/100V voltage divider, four 5-300vK/100V voltage dividers, four dischargers with noninductive shunts, disconnect and protective switches, a pressure gauge and recording device, travel recording device, automatic test control

equipment with frequency divider and synchronizer. For simultaneous recording of fast varying processes there a magnetoelectrical complex is added which contains two 12-channel light-beam oscillographs N-115 with 0-15 kHz frequency range. There are also a 12-channel electron-beam oscillograph 120EMZ with mechanical swepp and 0-5 kHz frequency range for recording current and voltage transients of $10 \mu\text{s}$ - 1 s duration, a 3-channel cathode-ray oscillograph 3K0-20 for simultaneous recording of three electrical processes of up to $0.1 \mu\text{s}$ duration, and a 5-beam electron-beam oscillograph S1-33 for recording periodic and pulse processes. The equipment is used for testing 110 kV and 220 kV air-type and oil-type circuit breakers with current ratings up to 63 kA. Figures 2; tables 1; references: 1 Russian. [187-2415]

UDC 621.3.08

REPRODUCTION OF A VOLTAGE UNIT WITH LONG-LIFE JOSEPHSON POINT JUNCTIONS BASED ON NIOBIUM SINGLE CRYSTAL

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 83 pp 31-32

KRZHIMOVSKIY, V. I., AYNITDINOV, Kh. A., BOROVITSKIY, S. I. and GOKHNER, A. S.

[Abstract] Since 1980 a unit of emf in the Government volt etalon has been reproduced at a new accuracy level (irreducible systematic error $< 10^{-6}$, random error or standard deviation $< 5 \cdot 10^{-8}$) on the basis of the transient Josephson effect in $\text{Pb-Pb}_x\text{O}_y\text{-Pb}$ tunnel junctions. However, these devices have a short lifetime, and consequently Josephson junctions on a niobium single crystal are proposed instead. The equipment for transfer of the voltage unit to secondary standards consists of a cryostat containing a pair of such Josephson junctions in series, with a center tap across an adjustable d.c. voltage source and with superconducting lead shields, the cryostat being placed inside a magnetic shield. A set of normal voltage cells is placed inside a thermostat and connected through a voltage divider to another adjustable d.c. voltage source. Both the set of cells and the pair of Josephson junctions are also connected to a microwave oscillator with automatic phase control and frequency synthesizer. The equipment includes two voltmeters and automatic recording instruments. Maximum power transfer requires that the low impedance of Josephson junctions ($\sim 0.1 \text{ ohm}$) be matched to the characteristic impedance of the transfer channel (50 ohms), which is achieved by means of a cavity resonator with a Q-factor of at least 100. All basis characteristics of this cryogenic converter determining the feasibility of its use for transfer of a voltage unit have been measured and evaluated within the 8.2-9 GHz frequency band, namely: critical current, width and height of current steps on the current-voltage characteristic and voltages at which they occur, excitation power corresponding to maximum height of n-th current step, and power at zero crossover (n- 0 current step of width $\Delta I = 0$). The results indicate that such Josephson junctions are reliable and their parameters have a high degree of time stability. Figures 4; references: 5 Russian. [187-2415]

INSTRUMENT FOR MEASURING ELECTRIC FIELD INTENSITY IN HIGH-VOLTAGE EQUIPMENT

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 1, Jan 83 pp 48-49

KLIMASHEVSKIY, I. P., KONDRAT'YEV, B. L., POLETAYEV, V. A. and YURKEVICH, V. M.

[Abstract] An instrument has been developed for determining the electric field intensity in high-voltage equipment such as transformers. Its measuring part includes a primary transducer with miniature probe, amplifier, and channel switch (three channels: two field components E_x, E_y and equalizing probe potential φ_e), and a 100 MHz ultrashort-wave transmitter. A plane capacitor serves as a probe which, when in fixed position, makes possible measurement of only one component of the electric field intensity vector at a time. The indicating part, located outside the field, includes an ultrashort-wave receiver and an analog-to-digital converter, the latter with filter, detector, and voltage-to-frequency converter (0.1% accuracy within 0-80 kHz range). The output from this converter, in the form of rectangular pulses, is fed to a digital signal processor. The instrument should operate at voltages below the corona-discharge level and thus without r-f interference in the transmitter-receiver radio channel. The characteristics of the probe must be known beforehand for correct recording of nonaxisymmetric fields with an XY-plotter. Figures 2; references: 2 Russian. [158-2415]

UDC 621.3.084.89:539.1.074

METHOD OF MEASURING DOSES OF IONIZING RADIATION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 83 pp 47-48

MOROZOV, N. N. and STEPANOV, B. M.

[Abstract] A method of absolute measurement of ionizing radiation doses is described which involves microwave probing of a gas made electronegative by pulses of x-ray or γ -ray bremsstrahlung. A waveguide is formed inside a gas-filled cavity in air-equivalent material. Measurement of the radiation dose is based on the rate of electron-ion pairing, the latter indicated by the saturation current in the external circuit. The theory of this method is based on attenuation of centimetric and decimetric waves in such a waveguide, with negligible phase shift, and on the pressure dependence of the frequency of electron-molecule collisions in the case of uniform irradiation of the gaseous cavity and small perturbations of electromagnetic waves by the plasma. In a sufficiently small cavity under nearly normal pressure the rate of electron-ion pairing is proportional to the power of the exposure dose. A plane-parallel geometry is preferable for measurement of directional radiation beams and, therefore, the primary converter of radiation dose to electric signal ought to have a cylindrical shape. The method was tested by the All-Union Scientific

Research Institute of Metrology imeni D. I. Mendeleev for sensitivity and accuracy. A cylindrical chamber 4.5 mm high and 50 mm in diameter, with 2mm thick walls of polymethyl methacrylate and 20 cm long stipline aluminum electrodes deposited on the parallel faces, served as a transducer. Voltage pulses were measured with a V4-17 voltmeter (2.5% accuracy), constant voltages and currents were measured with a V7-21 universal voltmeter (1% accuracy). The electrical conductivity of the gas was determined from the pulse current in an electric field of up to 50 V/cm intensity and thus within the linear range of the current-voltage characteristic. Results obtained after integration of a radiation pulse with respect to time and evaluation of systematic as well as random errors have been compared with results obtained by the thermoluminescence method with an LiF crystal. Both methods agree within their limits of accuracy. The microwave method is applicable to radiation pulses of 10^{-8} - 10^{-6} s duration and power of exposure dose up to 10^9 A/kg ($4 \cdot 10^8$ R/s), with the error reducible to $\pm(7-10)\%$. Figures 2; tables 1; references: 5 Russian. [187-2415]

UDC 621.3.087.92:621.3.025

HIGH-SPEED MICROPROCESSOR-TYPE TRANSDUCER OF EFFECTIVE A.C. VOLTAGE

Moscow IZMERITEL'NAYA TEKNIKA in Russian No 1, Jan 83 pp 57-59

[Abstract] Combining a transducer of r.m.s. voltage with a microcomputer will improve its performance, particularly critical being the operation of square-root extraction. In the open-loop version the microprocessor scaler is followed by a non-inductive squarer and a low-pass filter in series, the closed-loop version being less stable and more complex. The speed is increased by increasing the number of filter sections and decreasing their time constants. The transducer is coupled to a microcomputer directly and through an analog-to-digital converter behind the filter. This arrangement allows for automatic range selection as well as for correction of additive error and multiplicative error. Correction of the additive error widens the dynamic range and shortens the selection time. The algorithm is set by the microcomputer, in whose direct-access memory the transducer output is encoded in the form $A = cV_x^2 + c\Delta V^2$ (c - constant, ΔV - additive voltage error). Such a transducer has been designed for use in a multipurpose meter with built-in microcomputer. The microprocessor scaler consists of a high-impedance capacitive-resistive voltage divider with input capacitor, a switching logic, a voltage follower with overload protection, a low-impedance output voltage divider, and an amplifier. The noninductive squarer is a semiconductor multiplier-divider with controllable conductances. A prototype of this transducer was tested experimentally, with a minicomputer instead of microcomputer. It covers voltages from 1 mV to 500 V in six overlapping ranges. Its normalized fundamental error does not exceed 0.2% and its frequency error does not exceed 0.08% over the 0.02-100 kHz range. One measurement is made within 0.6 s, any range is selected automatically within 1.5 s, the additive error is determined within 1.5 s, and the time between two successive corrections is 2 min. The input impedance is at least 1 Mohm and the input capacitance is at most 100 pF. Figures 3; references: 2 Russian. [158-2415]

ACCURACY OF CALCULATION OF ELECTROSTATIC FIELDS IN HIGH-VOLTAGE MEASURING INSTRUMENTS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 1, Jan 83 pp 46-48

YAROSLAVSKIY, V. N. and ZHURAVLEV, E. N.

[Abstract] In order to prevent corona and leakage in high-voltage instruments with electrodes of intricate shapes, such as electrostatic voltmeters and various voltage dividers, it is necessary to know the electrostatic field distribution and also the partial capacitances of sensitive instrument components. Experimental determination is difficult or impossible, so calculations must be very accurate. A widely used method of calculation is that of equivalent charges. It involves solving the Laplace equation $\nabla^2 f = 0$ with boundary conditions $L_B f = f_B$ in series of nonorthogonal functions $f_B = \sum_{j=1}^N Q_j \psi_j$

(Q - coefficients of linear combination). The error of calculation by this method, which depends largely on the approximation of the boundary conditions, can be estimated according to the theorem of maximum modulus of harmonic functions and by using the maximum of the function of deviations Δ from the boundary conditions as the upper bound. This procedure is followed here, assuming first that the boundary is rectilinear and has been subdivided into segments of equal lengths. It is also assumed that ψ is the fundamental solution to the Laplace equation with a singular point at some distance from the boundary, that L_B is the operator of idem transformation $L_B(\psi) = \psi$ (Dirichlet problem), and that on each segment of the boundary only one of the basis functions has a third derivative with a significant value. Numerical estimates by this method of maximum modulus made for boundaries of various forms indicate that the method is reliable and more accurate than other methods of error estimation, specifically a posteriori error estimation by repeated solving of the Laplace equation $\nabla^2 \tilde{\Delta} = 0$. Figures 1; references 6: 3 Russian, 3 Western.
[158-2415]

UDC 621.317.714/725

HIGH-SENSITIVITY D.C. INSTRUMENTS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 1, Jan 83 pp 50-51

MINTS, M. B., STEPANENKOV, G. G. and TKACHENKO, A. N.

[Abstract] Magnetogalvanometric instruments with Deprez-d'Arsonval movements such as the 14 modifications of model M17 are being gradually replaced by high-sensitivity d.c. instruments with photogalvanometric autocompensators (microvoltammeters F138 F139, nanovoltammeters R341, microwebermeters F191) or with field-effect transistor amplifiers (microvoltammeter F136, microwebermeter F199), the latter featuring also a high immunity to mechanical interference

effects. The sensitivity of the former approaches the theoretically attainable limit, which is determined by thermal noise. On the basis of a comparative evaluation with the information/energy efficiency $\eta = W / \gamma^2 P t$ ($W_s = 3.5 \cdot 10^{-2}$ J a constant, γ - fundamental instrument error, P - power^s drawn from object of measurement, t - reading stabilization time), instruments with photogalvanometric autocompensators are preferable in the microampere range and instruments with transistor amplifiers are preferable in the microvolt range. Tables 1; references: 6 Russian. [158-2415]

UDC 681.785.24

RESOLVING POWER OF REFLECTOMETER WITH COMPENSATION OF CLUTTER

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 16 Nov 81) pp 29-30

MOISEYEV, V. V., POTAPOV, V. T., SVIRIDOV, V. A. and SOKOLOVSKIY, A. A.

[Abstract] A fiberoptic reflectometer is considered which has compensation of clutter by means of an added reference channel. The output signal of this channel is subtracted from the output signal of the measuring channel. The resolving power of such a reflectometer is principally limited by thermal noise in the photocurrent amplifier and by noise associated with background illumination of the photodiodes. An evaluation of the reflectometer performance based on the best attainable noise characteristics reveals that the sensitivity of such a device to changes in the reflection coefficient is inversely proportional to the fiber input power when the latter is low (background noise negligible) and inversely proportional to the square root of the fiber input power when the latter is high (background noise dominant). According to available data, at input power levels above 10 mW the reflectometer resolution does not depend on the quality of the measuring photoreceiver. Figures 2; references: 1 Western. [123-2415]

CATHODE-RAY TUBES FOR OSCILLOGRAPHS

Moscow RADIO in Russian No 2, Feb 83 p 32 (and one page of insert)

GERASIMOVICH, M.

[Abstract] Modern cathode-ray tubes for oscillographs are built with electrostatic deflection systems and are capable of recording signals with an upper frequency limit of 20-30 MHz. High sensitivity of deflection is attainable through postacceleration of the electron beam, with a convex metal grid included in the electron-optics behind the deflection plates and a layer of current-conducting materials deposited on the tube envelope. High linearity of deflection

is achieved with a flat screen, although focusing is somewhat worse than on a spherical one. Magnetic deflection systems have a better resolving power, but their frequency range is lower. The size (diameter) of available screens ranges from 3 to 23 cm, the beam deflection angle being always within 12-18°. The reference grid lines are drawn on the inside surface, in order to ensure more accurate reading without parallax. Widely used single-layer screens have CdS or ZnS phosphor coatings for a green glow with 10^{-2} - 10^{-1} s persistence. The image contrast and thus the measurement accuracy are improved by a thin film of light metal (aluminum) on top of the phosphor coating. The article is directed to educational organizations of DOSAAF (All-Union Order of the Red Banner Society of Assistance for the Army, Aviation and the Navy). [184-2415]

UNIVERSAL SERVICE OSCILLOGRAPH S1-94, PART 2: CONSTRUCTION - COMPONENTS - ADJUSTMENTS

Moscow RADIO in Russian No 2, Feb 83 pp 29-31 (and two pages of insert)

BULYCHEVA, N. and KONDRAT'YEV, Yu.

[Abstract] The S1-94 universal service oscillograph (RADIO No 1, Jan 83) is built as a table instrument with vertical construction. The chassis consists of a base plate and a top plate, both stamped, between a front panel and a rear panel made of an aluminum alloy. The cathode-ray tube is plugged into a socket in the rear panel, its screen and controls are framed into the front panel. Horizontal deflection and vertical deflection are installed so as to minimize the output capacitance and thus maximize the bandwidth. Printed-circuit boards carry resistors, capacitors, and switches. A side plate and shelves are added for mounting the low-voltage power supply with line transformer, the high-voltage transformer with diodes for the cathode-ray tube, and the preamplifier. The instrument has been laid out for individual assembly and convenient operation. Only preliminary adjustments are needed, namely visual inspection and correction of mechanical errors, measurement and correction of voltages across components, warm up, control of light spot and sweep line, and possibly correction of the frequency characteristic of the vertical deflection. Instructions are given, the procedure is outlined, and all necessary parts with catalog data are listed. Figures 1; tables 3; references: 8 Russian.

[184-2415]

TIME AND FREQUENCY SERVICE IN USSR

Moscow RADIO in Russian No 2, Feb 83 pp 14-16

KRASNOV, Yu., candidate of technical sciences, and PUSHKIN, S.

[Abstract] The USSR Time and Frequency Service was established in 1920, reorganized and improved in 1948, then again modernized in 1952 and in 1967. Now time and frequency signals are transmitted over a short-wave and long-wave radio network with stations in Moscow, Irkutsk, Novosibirsk and Tashkent. Equipment used for this purpose includes high-precision quartz clocks and automatic control. A second was defined originally on the basis of a mean solar day, then on the basis of a tropical year, and in 1967 redefined from an astronomical to an atomic unit (as the period of 9,192,631,770 oscillations at the frequency of transitions between energy levels in a Ce^{133} atom in an unperturbed magnetic field). The ensemble of time and frequency etalons consists of primary standards (cesium, hydrogen, rubidium) kept under strictly constant microclimatic conditions in vaults of the All-Union Scientific Research Institute of Physico-Technical and Radio Technical Measurements, and secondary standards. The unit of time is now reproducible with an error not exceeding 5.10^{14} . All etalons are precisely synchronized. Appurtenances include internal and external comparators and maintenance equipment. New and better methods of comparison and checking are being developed in order to ensure minimum loss of accuracy in transmission. Use of meteor trail radio channels is very promising, synchronization between master and local stations as far as 1500-1000 km apart being achieved by orientation of antennas in order to ensure reflection of correspondent signals by the same meteor trail. Figures 1; tables 1; references: 3 Russian.

[184-2415]

UNIVERSAL SERVICE OSCILLOGRAPH S1-94, PART 1: BASIC CIRCUIT

Moscow RADIO in Russian No 1, Jan 83 pp 37-42

BULYCHEVA, N. and KONDRAT'YEV, Yu.

[Abstract] A service oscillograph, model S1-94, has been developed and built for repair workshops and factories as well as educational laboratories and radio amateurs. It is designed to analyze pulse signals of 10 mV - 300 V amplitude and 0.1 microsecond - 0.5 s duration as well as sine-wave signals of 5 mV - 150 V amplitude and up to 10 MHz frequency, covering the range used for industrial equipment and consumer appliances. The oscillograph includes a cathode-ray tube with a $40 \times 60 \text{ mm}^2$ effective screen area, vertical and horizontal deflection system, sweep and synchronization, calibration and interlocking. It operates on 220 V - 50 Hz, requires 5 min warm-up time, draws a power of not more than 35 W, and weighs not more than 3.5 kg. Its schematic block diagram and basic electric circuit diagram are shown, all components are defined and their operation is described. Part 2 of the article will follow. Figures 2.

[170-2415]

MAGNETICS

UDC 681.846.7

SYNCHRONIZER FOR 'REPORTER-6' MAGNETIC SOUND RECORDER

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 2, Feb 83 pp 56-57

BURKATSKIY, S. S. and GUBOV, I. A., Kherson Radio Telecommunication Center

[Abstract] A synchronizer has been developed and built for the "Reporter-6" magnetic sound recorder which facilitates simultaneous playback of phonograms from 6.25-mm magnetic tape during dubbing on KZM-22 or other equipment operating at 50 Hz line frequency. It includes a pilot-tone amplifier, a comparator, a recorder control, and a power supply. The amplifier consists of two transistors and an OU1 microcircuit; it amplifies the pilot tone to 2 V, voltage level of the 50 Hz reference signal with which the output signal of the pilot-tone playback amplifier is to be compared. The comparator consists of two transistors forming rectangular pulses, two differentiating RC circuits, two diodes, and a trigger containing one of the two transistors and another one. The synchronizer includes automatic control which maintains synchronization at line frequency while the pilot-tone frequency fluctuates over the 47-53 Hz range. There are two indicator lamps on the front panel, also an adjustable resistor for setting the recorder to optimum operation. A third lamp feeds light to a photodiode acting as a variable resistance for automatic control of the recorder motor. Figures 2.
@189-2415]

UDC 621.318

CONSTRUCTION OF SELECTIVE MICROWAVE NETWORKS USING FERRITE RESONATORS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 6 Aug 81)
pp 60-64

GOLOBOV, V. P., TUREYEVA, O. V., TSYMBAL, V. I. and SHELAMOV, G. N.

[Abstract] The design of microwave devices with magnetic frequency control includes synthesis of selective networks with ferrite resonators according to a given input impedance or transfer ratio. Here the procedure of synthesis according to the given normalized input impedance is applied to microwave networks with a "ferrite resonator in one loop" (two-pole network) and with a "ferrite resonator in two orthogonal loops" (selective-matching four-pole network). General design formulas are derived and their use is demonstrated on numerical examples of four kinds of devices: 1) microwave oscillators with a silicon transistor in a common-base circuit; 2) 10 GHz microwave oscillator with Gunn-effect diode; 3) selective detector with Schottky-barrier diode; 4) frequency converters. Input data and calculation program have been tabulated for a BZ-21 microcalculator. Appendices 4; references: 7 Russian. [123-2415]

UDC 621.382

PHYSICAL PROPERTIES AND FUNCTIONAL CAPABILITIES OF ZINC-COMPENSATED SILICON STRUCTURES

Moscow MIKROELEKTRONIKA in Russian Vol 11, No 6, Nov-Dec 82 (manuscript received 12 May 82) pp 539-550

ARUTYUNYAN, V. M., Yerevan State University

[Abstract] Physical properties of zinc-compensated silicon and technological characteristics of injection diodes with $p^{+}nn^{+}$ or $p^{+}n^{+}$ structure built on this material are reviewed in the light of up-to-date theoretical and experimental research. Of particular interest are photoelectrical properties, excitation of recombination waves, injection and generation phenomena, current-voltage

characteristics with sublinear range, photosensitivity, cutoff, gain, temperature dependence and radiation dependence. Results of studies made by the author are compared with already known data and interpreted in terms of possible operating mechanisms. The properties of Si <Zn> semiconductor material and the characteristics of S-diodes, photodiodes, and resistors made of it suggest a wide range of applications for them in microwave and optoelectronic equipment, automation hardware, and microelectronic technology. The author thanks Z. N. Adamyanyan and F. V. Gasparyan, as well as other staff members at the Laboratory for Physics of Semiconductor Devices (Institute of Radiophysics and Electronics, ArSSR Academy of Sciences), and the Laboratory for Physics of Semiconductor Materials (Yerevan State University), who participated in the research, for discussing this report. Figures 5; references 69: 57 Russian, 12 Western (3 in translation).
[122-2415]

UDC 621.382.8

CHARACTERISTICS OF LOGIC-STRUCTURAL REALIZATION OF PROCESSOR-ORIENTED VLSI MEMORIES

Moscow MIKROELEKTRONIKA in Russian Vol 11, No 6, Nov-Dec 82 (manuscript received 29 Jan 82) pp 512-519

LAPSHINSKIY, V. A., Moscow Institute of Engineering Physics

[Abstract] Logic-structural aspects and special techniques of producing VLSI memory chips are examined, foremost among them being active-passive supply configuration and structural-topological redundancy. Multifunctional use of control modules, busbars and terminal tabs is also considered. In devices with multi-functional control modules the optimum combination of the latter will depend on the mode of storage and access as well as on the required high operating speed and the permissible power dissipation. The power drawn can be minimized by programming the supply pulses to the control module in terms of duration and delay time. The power requirement can also be lowered by use of structural-topological redundancy and by operation at higher speeds, which is attainable through segmetalization of the storage with address pulse shapers and pulse shaper-amplifiers placed between segments. The realization of a basic memory chip is determined by the maximum number of memory cells around the chip perimeter and by the allowable redundancy. Typical design calculations and performance estimates are shown for a VLSI memory based on the latest state of the art in diode and capacitor technology. Figures 5; tables 3; references 12: 11 Russian, 1 Western.
[122-2415]

DIGITAL PROCESSORS OF ANALOG SIGNALS: NEW TREND IN MICROCIRCUIT ENGINEERING

Moscow MIKROELEKTRONIKA in Russian Vol 11, No 6, Nov-Dec 82 (manuscript received 30 Mar 82) pp 520-538

ARUTYUNOV, P. A., DSHKHUNYAN, V. L. and YEMEL'YANENKO, V. A., Moscow Institute of Electronic Machine Design

[Abstract] A new trend in microcircuit integration is set by single-chip digital processors of analog signals, based on periodic discretization of the latter with subsequent quantization and coding of each sample. Such processors, operating in real time with properly selected uniform discretization interval and frequency for minimum error, are very efficient. Processing algorithms with a precise structure are preferable, particularly for implementation on special-purpose single-chip microcomputers. The four algorithmic structures most widely used for this application are recursive second-order filters, "distributed arithmetic", canonical sign-number code, fast Fourier transformation, and signal graphs. Such a processor can operate with programmable read-only memory, read-only memory, direct-access memory, and high-speed memory. Its hardware includes: quartz timer with synchronizer and memory control on first level; arithmetic unit with data register on second level; input multiplexer, A/D converter, D/A converter, and output demultiplexer on third level. Various architectures are possible, as illustrated with a processor using the algorithm of canonical sign-number code. Processors of this type are manufactured by Intel Co (model I 2920) and American Microsystems Inc (model S 2811). Voice processors are manufactured by Bell Laboratories (model DSP) and Nippon Electric. Further development of the technological base for such processors, with very-large-scale integration as a target, will involve combining and trading off the advantages of injection logic, bipolar, NMOS and KMOS (silicon and GaAs) devices. Figures 7; tables 3; references 26: 16 Russian, 10 Western (3 in translation).
[122-2415]

CHARACTERISTIC FEATURES OF CONTROL OF FOUR-POLE ELECTROMAGNETIC RADIAL BEARING

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 1, Jan 83 pp 61-64

VEYNBERG, Dmitriy Moiseyevich, candidate of technical sciences,
VERESHCHAGIN, Vladimir Petrovich, candidate of technical sciences, and
SPIRIN, Aleksandr Vasil'yevich, engineer

[Abstract] Fundamental equations are derived for a four-pole electromagnetic radial bearing which take into account magnetic coupling but disregard drops of magnetic potential in the iron core and effects of cylindricity of the stator bore. These equations yield the forces produced by voltages applied to the four windings on the four poles and acting on the rotor with the latter in any position. The reverse problem of control, namely determining the voltages necessary for producing given centering forces on the rotor, is solved with additional constraints of minimum magnetic fluxes and minimum power loss. These constraints lead to a unique correspondence between two orthogonal centering forces F_x, F_y and magnetic fluxes $\Phi_{13} = \Phi_1 - \Phi_3$, $\Phi_{24} = \Phi_2 - \Phi_4$, $\Phi = \Phi_1 + \Phi_3 = \Phi_2 + \Phi_4$ (poles 1,3 opposite, poles 2,4 opposite), also between control voltages V_{13}, V_{24} and supply voltages $V_1 = 1/2(V + V_{13})$, $V_2 = 1/2(V + V_{24})$, $V_3 = 1/2(V - V_{13})$, $V_4 = 1/2(V - V_{24})$ where $V = 1/2(V_1 + V_2 + V_3 + V_4)$. These relations can be implemented by a control system with feedback of the rotor position, the simplest one being with opposite poles connected in series, so as to provide also necessary astaticism and damping. Such a system was tested experimentally in a suspension of a rotor weighing 40 kg and running at a speed of 10,000 rpm. Figures 3; references 4: 3 Russian, 1 Western.

[188-2415]

CHANGES IN STANDARD FOR QUALITY OF ELECTRIC POWER

Moscow ELEKTRICHESTVO in Russian No 1, Jan 83 (manuscript received 26 Feb 82)
pp 61-63

ZHEZHELENKO, I. V., doctor of technical sciences, and NIKIFOROVA, V. N.,
candidate of technical sciences

[Abstract] The Government Standard 13109-67 "Electric power. Norms for quality of electric power and its receivers connected to general-purpose networks" has been found to be inadequate in some areas of engineering and management requirements. Appropriate changes have subsequently been made. One change appears in the terminology and definitions. Voltage fluctuations are now evaluated on the basis of their swing and frequency as well as the time interval between successive voltage changes, the swing of voltage changes being defined as the difference between successive extrema on the envelope of rms values or between an extremum and the adjacent horizontal segment. This change makes evaluation of power requirements for machine tools and electric-arc welders more realistic. A second change pertains to quality control measurements, namely stipulations have been added as to the length of measuring periods for various types of equipment in various types of enterprises. Such measurements, to be generally made during one day, include waveform factor, ripple factor, and negative-sequence factor. Other changes to be made concern confidence levels, tolerances, accuracy and other characteristics of measuring instruments, as well as the responsibilities of the energy producer and energy user, respectively. Figures 2; references: 4 Russian.
[153-2415]

UDC 621.311.1.027.3.001.24

ECONOMICAL VOLTAGES AND POWER LEVELS FOR MUNICIPAL DEEP FEEDERS

Moscow ELEKTRICHESTVO in Russian No 2, Feb 83 (manuscript received 30 Jun 82)
pp 20-25

GLAZUNOV, A. A., KUZNETSOVA, T. A. and FEDOSYEV, A. A., Moscow Institute of
Power Engineering

[Abstract] A technico-economical model of supplying a city with high-voltage electric power from external substations around the periphery is constructed on the basis of an idealized topological model of the city territory. In this model the city is represented by a circle and as such, subdivided into sectors, each supplied from a substation through intermediate-voltage 10(6)-20 kV radial or trunk feeders and step-down (to 380 V) distribution transformers. Assuming an averagely uniform load density, typical of a city with residential and small industrial users, the power levels are proportional to the sector areas covered. The problem of optimizing voltages and power levels is solved with respect to

normalized annual costs as a criterion. Reliability of the results is ensured by two methods of checking them. The first method involves estimating the errors incurred by averaging of coefficients and power exponents in the technico-economical model. The second method involves establishing analogies to practical data on the design of actual electric power supply systems for the largest cities in the Soviet Union and abroad. Studies made on this basis indicate that deep cables are generally economical at the base substation voltage, radial feeders being preferable for cities smaller than 15 km in radius and pairs of trunk feeders being preferable for cities larger than 15 km in radius. Optimum voltages are 110 and 210 kV for power densities of 5 and 20-30 MW/km² respectively. Figures 6; tables 4; references: 14 Russian. [169-2415]

UDC 621.311:621.398

IMPROVING EFFICIENCY OF EQUIPMENT FOR TELEMETRY OF POWER SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 1, Jan 83 (manuscript received 30 Mar 82)
pp 59-61

MAYBORODA, G. A. and SKRYL', V. F., Kiev

[Abstract] Conventional discrete telemetry by pulse-code methods with data processing by a digital computer is the simplest but not the most efficient for remote control of power systems. It is necessary not only to shorten the discretization period on the receiver side and thus improve the accuracy of the staircase approximation, but also to improve the reliability by decreasing the missed-hit probability. This can be achieved by aperture control of received communications. Successive values of a parameter read on the receiver side are compared and a tolerance range (aperture) is established on this basis. A smaller aperture means less redundancy in the communication and a shorter required time for transmission, but also a higher probability of overshoot between successive readings and thus a longer required discretization time on the receiver side. Aperture control takes into account the statistical characteristics of power system parameters involved in telemetry as well as the strong correlation of successive readings. The correlation characteristics of such parameters were studied in several power systems (500 kV line from the Novovoronezh Atomic Electric Power Station to Donets basin, 300 kV line from the Zmiyevka State Regional Electric Power Station to Belgorod, aggregate of four lines from Southern region to Central region) at various power levels and under various operating conditions. The correlation time was found to vary within the 500-600 s range and the correlation coefficient to approach unit in almost all cases with readings taken in 0.5-10 s intervals. On the basis of these data and general relations applicable to power systems, the probabilistic reliability parameters of aperture control have then been calculated. The results indicate that this method is particularly efficient when the transmission speed is high and is preferable to other models such as plain algebraic control when the interference level in communication channels is high. Figure 2; tables 1; references: 2 Russian. [153-2415]

EXPERIMENTAL STUDY OF LINEAR CONDUCTION MOTOR WITH SEALED LIQUID METAL CURRENT INPUT

Moscow ELEKTRICHESTVO in Russian No 10, Oct 82 (manuscript received 27 Jan 82)
pp 57-59

KHOZHAINOV, A. I., KUZNETSOV, S. Ye., doctors of technical sciences,
ANDREYEV, V. I., candidate of technical sciences, and PITULAYNIN, N. M.,
engineer, Leningrad

[Abstract] Experiments are conducted in order to verify the theoretical study of a linear conduction motor with sealed liquid metal current input [see A. I. Khozhainov, ELEKTRICHESTVO, No 5, 1979]. The motor armature is a copper plate in a hermetically sealed textolite channel of rectangular cross section filled with mercury. In each of the vertical walls of the channel there are 12 copper electrodes of circular cross section 10 mm in diameter and connected in parallel by a copper busbar. Alternating voltage is applied to the busbar. Elastic chambers keep the channel sealed, ensuring that the velocity of the plate is equal to the average velocity of the liquid metal in the gaps of the channel. The ends of the armature are thickened by a polyfluorethylene resin facing equalizing clearances between the channel walls and the armature, and preventing liquid metal from seeping into the cavity of the elastic chambers. The channel of the electric motor is placed in the gap of a DC electromagnet with independent excitation. As a result of interaction of the alternating current flowing through the channel with the external magnetic field produced by the electromagnet, an electromagnetic force arises that drives the plate in reciprocating motion. Analysis of the experimental results yields a maximum efficiency of 20% for the linear motore. This relatively low efficiency is caused by the high contact resistance on the copper-mercury interface and the connection between electrodes and busbars. Design improvements should aim at minimizing all contact resistances. Figures 4; references: 2 Russian. [180-6610]

PERFORMANCE STABILITY OF SUPERCONDUCTOR FIELD WINDING IN CRYOGENIC DIRECT-CURRENT POWER MOTOR

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIK in Russian No 1, Jan 83 (manuscript received 25 Mar 81, after completion 14 May 82)
pp 44-47

DAN'KO, Vladimir Grigor'yevich, doctor of technical sciences, professor, deputy director, "Elektrotyazhmash" (Heavy Electrical Machinery) Works' Scientific Research Institute, Kharkov; MILEKH, Vladimir Ivanovich, candidate of technical sciences, senior instructor, Kharkov Polytechnic Institute, STANKEVICH, Antolii Ivanovich, junior research worker, Kharkov Polytechnic Institute

[Abstract] Losses in a cryogenic reversible d.c. motor with a superconductor field winding and helium (gas) cooling are analyzed from the standpoint of a

design for a higher power rating with higher power-to-volume ratio. A type-2 superconductor material is considered, taking into account the fact that excessive heat generated by alternating electric current or magnetic flux will cause its transition to normal state. When the load current changes, under transient conditions, then a variable magnetic field is produced by the armature, interpole, and compensating windings which superposes on the constant magnetic field and causes additional losses and heating of the field conductors. Calculations by the finite-difference method, also taking into account saturation of the ferromagnetic components and based on the C.P. Bean model of critical state, reveal that most losses occur in the part of the main field winding closest to the armature core and the pole shoes. These losses may not be sufficiently high to raise the temperature of the cooling helium gas but sufficient to cause transition of the superconductor to normal state. It appears feasible to raise the magnetic induction in the air gap to 1.5-2.5 T and thus increase the power density in the motor, but superconductor materials with higher critical levels, such as intermetallic compounds, are recommended for use in this application. The critical parameters depend on so many factors that theoretical estimates must be refined with experimental data. Figures 1; tables 1; references 9: 6 Russian, 3 Western (1 in translation). [188-2415]

UDC 621.313.82

SELECTION OF STRUCTURE FOR ELECTRIC MACHINES WITH HIGH-COERCIVITY PERMANENT MAGNETS

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 83 (manuscript received 3 Dec 81)
pp 51-53

LEDOVSKIY, A. N., candidate of technical sciences

[Abstract] Intermetallic compounds of cobalt and rare-earth elements are most promising as permanent-magnet materials for electric machines designed to operate with an autonomous power supply. They feature a maximum energy product $(BH)_{\max}$ of 200 kJ/m³ or higher, high coercive force, magnetic permeability close to that of air, and a recoil curve coinciding with the demagnetization curve. For small electric machines of the rotating-field type with power rating up to 3 kW there are considered "spider" and "collector" rotor structures in the radial-machine configuration as well as a face-type rotor structure in the axial-machine configuration, each with either a slotted or slotless stator. Selection of structure and design of component parts (soft magnetic and non-magnetic ones in addition to the PM pole pieces) are based on the electric loading and dimensional factors, which depend on the operating speed and the required magnetic induction in the air gap as well as on the allowable current density in the armature (stator) winding with attendant cooling requirements. Both weight economy and efficiency are functions of the electric loading and of the energy product, the minimum weight/kVA and the maximum efficiency being attainable at some level of electric loading with a given PM material in a given rotor structure. Typical data and calculations are shown for radial machines with SmCo₆ magnets in a cylindrical rotor structure. Figures 5; references: 7 Russian. [152-2415]

STRESSED-STRAINED STATE OF ROTOR WINDING IN TURBOGENERATOR WITH SUPERCONDUCTING FIELD COILS

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 83 (manuscript received 31 Mar 82)
pp 23-25

DANILEVICH, Ya. B., doctor of technical sciences, professor, GLAZENKO, A. V., candidate of technical sciences, and KARYMOV, A. A., candidate of technical sciences, All-Union Scientific Research Institute of Electrical Machine Building

[Abstract] In the design of turbogenerators with superconducting field coils it is necessary to determine stresses and strains in the rotor coils. For a modular construction with flat coils in rectangular slots this can be done through solution of the corresponding two-dimensional problem in the theory of elasticity, in sections normal to the rotor axis. A coil is assumed to have a rectangular cross section and to consist of superconductor material only, with the presence of insulation consisting of glass-cloth and impregnation compound disregarded. Calculations are made for the steady-state mode of operation, under constant load and without temperature gradients. Compressive net electromagnetic forces and tensile centrifugal forces act on the rotor coils. The system of two differential equations of elasticity in displacements in a rectangular system of coordinates, supplemented with relations for the three stress components (normal, tangential, shearing), have been solved by the method of finite differences for appropriate boundary conditions at the coil retaining slot surfaces and with given standard expressions for the body forces. The solution yields the distribution of stresses and strains in coils. Calculations for a KTG-20 turbogenerator have yielded a stress of 376 kg/cm^2 in the most heavily stressed coil at critical current and runaway speed, much lower than the yield point of the superconductor-composite coil material. Figures 4; tables 1; references 6: 4 Russian, 2 Western.
[152-2415]

UDC 621.314.28-52.001.24

METHOD OF SYNTHESIZING SYSTEMS FOR OPTIMUM CONTROL OF THYRISTOR CONVERTERS

Moscow ELEKTRICHESTVO in Russian No 10, Oct 82 (manuscript received 15 Sep 81)
pp 29-34

ABAKUMOV, P. N., candidate of technical sciences, CHVANOV, V. A., doctor of technical sciences, Moscow

[Abstract] A method is proposed for synthesizing optimum control systems for thyristor converters where processes in the power circuit in the time interval between commutations of thyristors are described by ordinary linear inhomogeneous

differential equations with constant coefficients, assuming that the thyristors are ideal switches. A point whose coordinates completely describe the state of the circuits during this period is put into one-to-one correspondence with this state. A distinction is made between points of the steady state, perturbed points and transitional points. A perturbed point which is simultaneously a first transitional point describes a state that arises when some perturbation is applied to the steady state. Transitional points describe states on a given intercommutation interval in a transient process. Thus the beginning of the transient process in this representation is the occurrence of a point with coordinates different from those of a steady-state point. A solution is found for the problem of arranging commutations on the time axis so as to minimize the duration of the transient processes or to satisfy some other criterion. A numerical example is given. Figures 6; tables 1; references: 2 Russian. [180-6610]

UDC 621.314.214.332

INDUCTIVE-CAPACITIVE CONTROLLABLE TRANSFORMING DEVICES

Moscow ELEKTRICHESTVO in Russian No 12, Dec 82 (manuscript received 11 Mar 81)
pp 28-33

KULINICH, V. A., RSFSR, Gorkiy

[Abstract] The paper gives the working principle of a generalized transforming device: an inductive-capacitive unit intended for voltage control in industrial electric networks. Expressions are derived for the coefficient of transformation $\tilde{K}(j\omega)$ with respect to current and voltage. The equations that define these coefficients are simultaneously the expressions of the static characteristics of the corresponding devices. An analysis is made of the most general case of a multiphase inductive-capacitive system of transformation using Kirchhoff's law of electric networks, and assuming that the nodes of the multiphase system are connected by two-terminal networks of the generalized coupling branch type. It is shown that the voltage coefficient of transformation can be varied by regulating the parameters of the reactive elements in the device without changing the turns ratio. Dimensionless expressions are found for the reactive powers and voltages of the components of the transforming device. Figures 5; tables 1; references: 6 Russian. [181-6610]

EXPERIENCE IN FACTORY TESTING POWER TRANSFORMER INSULATION BY CLIPPED LIGHTNING VOLTAGE PULSES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 82 pp 52-56

BOCHENKO, A. S., GORBUNTSOV, A. F., GURIN, V. V. and FEDORENKO, V. A.,
engineers, "Zaporozhtransformator" Production Association

[Abstract] An analysis has been made of the results of tests of many hundreds of power transformers over a 17-year period (1964-1980) using clipped and unclipped lightning pulses. It was found that there had been difficulties in the past in deciphering oscillograms because of instability of the pre-discharge time when sphere gaps were used for clipping the lightning pulse. In recent years since the introduction of modern clipping devices the pre-discharge time has been appreciably stabilized. The clipped pulse method has been found to be highly sensitive in detecting damage to the internal insulation in power transformers. Distortion of the applied clipped pulse is recommended as a major criterion for rejecting tested transformers. Recommendations are made on substituting clipped pulse testing for unclipped pulse testing. Figures 3; tables 1; references: 2 Russian.
[182-6610]

METHOD OF DETERMINING CRITICAL CURRENT FOR LONG SPECIMENS OF CURRENT-CARRYING SYSTEM IN SUPERCONDUCTING CABLE

Moscow ELEKTRICHESTVO in Russian No 2, Feb 83 (manuscript received 1 Jul 82)
pp 35-40

BENDIK, N. T. and KOMISSARZHEVSKIY, N. Ye., Moscow

[Abstract] The critical current for ribbon and wire specimens of type-2 superconductors at a certain temperature can be determined experimentally from the current-voltage characteristic, with extrapolation of the latter to zero voltage. A simplification of this method is based on the voltage buildup to a certain level of the order of $1 \mu\text{V}/\text{cm}$. Its application to long tubular specimens used in cables is problematic because of heating with attendant longitudinal temperature gradients, as well as the transverse temperature gradient associated with galvanic connection between regions at room temperature and cryogenic temperature, respectively. Taking these factors into account requires an analysis of current and voltage transients and of the current-voltage characteristic during a transient period. A tubular copper conductor with a large diameter-to-thickness ratio and with a coating of type-2 superconductor material on the outside surface is considered for the purpose of such an analysis. An exponential current buildup is assumed and the appropriate Maxwell field equations are used. The error of current measurement

is also estimated, as a function of the sensitivity threshold and the time constant of the recording instrument. The dynamic errors of a recording oscillographic galvanometer are estimated on the basis of the fundamental second-order differential equation of motion. Experimental data are reported pertaining to a 1 SPK-M cable, obtained with a VAK-125000 current source, an N-115 light-beam oscillograph, and an array of resistance thermometers. For a critical current of 5.52-5.75 kA the error of current measurement is typically 180-250 A or within 5%, but can be larger depending on the test conditions. In ribbon specimens the rate of current buildup is slower, as a rule, and electromagnetic transients do not significantly influence the results of measurements. Figures 6; references 8: 7 Russian, 1 Western. [169-2415]

UDC 621.316.1.019.34.001.24

EVALUATING RELIABILITY OF ELECTRIC SUPPLY SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 12, Dec 82 (manuscript received 19 Feb 82) pp 60-62

MUSTAFAYEV, R. I., candidate of technical sciences, and NOSOV, Yu. L., engineer, AzSSR, Baku

[Abstract] A method is proposed for approximate evaluation of the reliability of complex electric supply systems by using either specialized modeling devices or analog computers. The method is based on the concept of the minimum section that is predominant with respect to probability of failures, where failure is understood to mean total cessation of supply to the user, without consideration of partial outages. An algorithm is proposed for solving the problem by a critical-path method. Figures 4; references: 9 Russian. [181-6610]

UDC 621.316.925.064:621.316.1

IMPROVING EFFICIENCY OF THREE-PHASE AUTOMATIC RECLOSING ON 330-750 kV ELECTRIC POWER TRANSMISSION LINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 82 pp 56-59

FOKIN, G. G., engineer, All-Union Scientific Research Institute of Electric Power Engineering

[Abstract] An analysis is made of the automatic reclosing methods used on 330-750 kV power transmission lines. It is shown that the region of application of fast-acting automatic reclosure can be considerably extended by organizing prevention of reclosure in the case of severe kinds of short circuits. When quick-action units for controlling voltage and synchronism are

used with high-frequency protection on the line, it is advisable to use accelerated three-phase automatic closure on one end of the line, and three-phase closure with control of synchronism on the other end. The time of disruption of power transmission in this case is just slightly longer than with the use of rapid-acting automatic reclosure, but the time loss is compensated by elimination of unsynchronized reclosures and reclosures across a dead short on the second end. In the case of nearby severe short circuits it is advisable to organize inhibition of accelerated three-phase automatic reclosures, and when a special communication channel is provided between the ends of the line, to transfer the right of first closure to the opposite end of the line. When there is no communication channel between the ends of the line, alternating automatic reclosure with first closure on the end of the line farthest from the short circuit can be realized by providing both ends of the line with a combination of accelerated three-phase automatic reclosure inhibited in the case of nearby shorts with three-phase automatic reclosure with control of synchronism and a slight additional delay of the accelerated reclosure at one end. Figures 1; references: 6 Russian. [182-6610]

UDC 621.371.3:621.315.36

DESIGN OF MULTILAYER ELECTROMAGNETIC SHIELDS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received 7 Oct 81)
pp 76-79

ABRAMOV, K. K. and BALOVLENKOV, Ye. V.

[Abstract] The design parameters of multilayer electromagnetic shields for flexible cables are calculated by solving the equations of electrodynamics in a cylindrical system of space coordinates ρ, φ, z . The general solution is obtained through Fourier integral transformation with respect to time t and the longitudinal coordinate z . With the principle of superposition applied to shields which are linear, the particular solution is obtained in the form $f(\rho, h, n, \omega)e^{jhz + jn\varphi + j\omega t}$. The electro-magnetic field in a shield is determined uniquely when either the tangential component of E at both inside and outside surfaces is given or the tangential components of both E and H at one of the surfaces are given. The boundary conditions are that the tangential field components do not change at the boundaries between layers. An analytical solution is obtained for the field components sought as functions of the radial coordinate ρ , in the form of power or other series. The algorithm has been constructed for execution on a computer, with the consideration that the shield thickness is always much smaller than the shield radius. Figures 1; tables 1; references: 7 Russian. [123-2415]

DESIGN OPTIMIZATION OF SINGLE-MACHINE ASYNCHRONOUS FREQUENCY CONVERTER

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 83 (manuscript received 15 Jun 82)
pp 53-56

POPOV, V. I., candidate of technical sciences, GUR'YANOV, I. A., engineer,
MAKAROV, L. N., candidate of technical sciences, and CHEBURAKHIN, I. M.,
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[Abstract] A single-machine asynchronous frequency converter OPChS-200 Hz has been developed for commercial production using the basic construction of the AK-62/4 wound-rotor induction motor. Its rotor carries two separate three-phase windings, but in 54 instead of 48 slots, and runs at a slip $s_2 = 1 + (1 - s_1)p_2/p_1 \approx 4$ as a generator. Its stator carries two inductively decoupled three-phase windings: a two-pole one and a six-pole one. The windings have been laid out and designed so as to optimize the emf distribution, eliminating most parasitic even and odd harmonics and subharmonics, and thus minimizing the differential leakage, with the aid of the Gorges diagram. Test data confirm the results of calculations, according to which this OPChS-200 machine under a nominal load of 5.0 kW with a lagging power factor of 0.8 delivers a three-phase voltage of 232 V - 200 Hz at an efficiency of 68.4%. This performance is better than that of the existing OPCh-200-5 converter (65.5% efficiency), which the OPChS-200 will replace. The temperature rises in the windings at full load are 32.4°C (motor winding on stator), 30.2°C (generator winding on stator), 38.0°C (rotor), as compared with 40.0°C, 45.2°C, 45.8°C respectively in the OPCh-200-5 converter. The width of the air gap has been increased from 0.5 to 0.6 mm, which improves the magnetization characteristics and reduces stray losses while also increasing the overload capacity. Figures 3; tables 3; references: 7 Russian.
[152-1425]

USING TEST SIGNALS TO SIMULATE FERROMAGNETIC NONLINEAR ELEMENTS

Moscow ELEKTRICHESTVO in Russian No 10, Oct 82 (manuscript received 16 Feb 82)
pp 63-67

NOVOZHILOV, O. P., candidate of technical sciences, Moscow Institute of
Electronic Machine Building

[Abstract] Two methods have been suggested for computer simulation of ferromagnetic nonlinear components such as chokes and transformers, which reflect the reactive properties and also account for nonlinear dissipative effects in such elements. The first method involves approximation of the hysteresis loop of the ferromagnetic material, treating the component as a single-element

model with behavior described by the dynamic hysteresis loop. In this paper, the author considers the second method, in which the component is represented as two series-connected or parallel-connected two-terminal networks with well defined characteristics. One network reflects the reactive properties of the actual component, and the other simulates its dissipative properties. Practical techniques are proposed for implementing this method with determination of the characteristics of the two-terminal networks of the model from the known form of a test signal and response of the actual component. Requirements are formulated for the shape of test signals ensuring that the simulation problem has an analytical solution. Expressions obtained for the characteristics of the two-terminal networks of the model can be used to show how these characteristics depend on the form of the test signal. Figures 6; references: 10 Russian. [180-6610]

UDC 621.372:519.853

OPTIMIZATION OF PARAMETERS OF PULSE-TYPE POWER SUPPLIES

Moscow ELEKTRICHESTVO in Russian No 1, Jan 83 (manuscript received 20 Apr 81) pp 64-65

GUBAREV, G. G. and SEVERIN, V. P., Kharkov

[Abstract] The feasibility of connecting two pulse-type power supplies in parallel across a resistive-inductive load for generating a standard current pulse with a short rise time and long duration is examined on the basis of a design and performance analysis of such a system. Calculations are based on the system of differential equations describing the discharge process in the power supplies and the current transient in the load in accordance with Kirchhoff's laws. With typical constraints on and numerical values of fixed parameters, the optimum variable parameters are determined on the basis of an appropriate criterion. The optimization problem is formulated as one of nonlinear programming, solvable on a digital computer by the method of sliding tolerance. The results indicate that in this case two parallel power supplies are more efficient and economical than a single power supply for the same purpose. Figures 2; tables 1; references 8: 5 Russian, 3 Western (in translation). [153-2415]

DEVELOPMENT OF NEW STANDARD SERIES OF ELECTRIC MACHINES

Moscow ELEKTROTEKNIKA in Russian No 1, Jan 83 pp 2-3

RADIN, V. I., doctor of technical sciences

[Abstract] Induction motors which are the largest single item of electric machinery produced and used in the Soviet Union consume about half of all the electric energy generated. Their manufacture involves tens of thousands of

jobs, their maintenance and repair provides more than a million jobs. Standardization is very important here, especially from the standpoint of economy of critical materials: copper and electrical steel. Much progress has been made since the AO series (1949), a significant milestone being the 4A series (1971) according to IEC and CEMA standards. The AI series is now being developed in order to be ready for production in 1984. One line will meet IEC and CEMA standards, one line will meet SENELEC (West European) standards. It will feature class F insulation and low noise levels, typically 10-15 dB lower than that of the 4A series, as well as a typically 1% higher efficiency (82%) and a 2% higher power factor (0.86). If produced by the same technology as the 4A series, it will require 25% less labor and its mass content will be reduced to 7 kg/W, with sheet metal or aluminum largely replacing cast iron for frames. At the same time the 4P series of direct-current motors and diode motors are also being developed, for which various structural components of induction motors, particularly frames and end shields, are suitable and many technological processes can be adapted. Tables 1; references: 3 Russian.
[152-2415]

ACOUSTO-OPTICAL CONVERTERS BASED ON FIBEROPTICS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 82 (manuscript received, after completion, 19 Feb 82) pp 3-15

KRAVTSOV, Yu. A., MINCHENKO, A. I. and PETNIKOV, V. G.

[Abstract] Fiberoptic technology has been utilized in the development of three types of acousto-optical converters for hydrophones. Phase converters, with movable mirrors or with interference using single-mode or multimode fibers, record the phase shift of light waves under acoustic pressure. No optimum method of converting phase modulation of light in the fiber to modulation of light intensity at the photo-receiver has yet been found, but three methods of detection are used: homodyne, heterodyne, and phase scanning. Another promising method of acousto-optical phase conversion appears to be the use of autodyne laser systems. Amplitude converters record the changes in light intensity under acoustic pressure, either in the transmitted beam or in the reflected beam, or with sound modulating the light attenuation in the fiber. Another promising method of acousto-optical amplitude conversion is by tunneling from one fiber to a second fiber, segments of each a few centimeters long running parallel to each other a few microns apart. Polarization converters utilize the effect of acoustic pressure on interference of orthogonally polarized natural modes in a single-mode fiber. Sensitivity ($V/\mu\text{Pa}$) and threshold pressure ($\mu\text{Pa}/\text{Hz}^{1/2}$), i.e., pressure at which voltage of the output signal is equal to the rms voltage of the internal converter noise within a 1Hz frequency band are the two basic performance characteristics of acousto-optical converters, on the basis of which all types of these devices can be comparatively evaluated and their designs optimized. Up to now amplitude converters meet most technical requirements, even very stringent ones, more satisfactorily than the other types, and have excellent manufacturability at a low cost. Use of fiber optics makes it feasible to extend the applications for acousto-optical converters beyond acoustics, to electrical and magnetic measurements (ammeter, super-conducting quantum interference magnetometer) as well as to mechanical (flow rate, acceleration) and temperature measurements, in addition such devices as gyroscopes (Sagnac effect). Figures 11; tables 3; references 71: 8 Russian, 63 Western.

[123-2415]

UDC 541.64:678.742:539.107

EFFECT OF STRONG ELECTRIC FIELD ON MECHANICAL DURABILITY OF POLYETHYLENE

Moscow ELEKTRICHESTVO in Russian No 1, Jan 83 (manuscript received 24 Dec 81)
pp 55-57

ABASOV, S. A., KURBANOV, M. A., VELIYEV, I. M. and KULIYEV, M. M., Baku

[Abstract] A strong electric field applied to polymers at cryogenic temperatures has been found to decrease their mechanical durability appreciably. A study was subsequently made for the purpose of determining the mechanism of this degradation. Polyethylene film specimens were tested at temperatures from 77 to 300 K without an electric field and in a sinusoidally alternating (50 Hz) electric field of $(2.5-3.5) \cdot 10^7$ V/m intensity oriented at right angles to the direction of mechanical stresses within the 60-75 MPa range. The behavior of electric charges was tracked by thermoluminescence measurements. Maxima of thermoluminescence were found to coincide with minima of mechanical durability. The results indicate three possible operating mechanisms: 1) Charges bound to traps and defects generate an electrostatic field which perturbs chemical and intermolecular bonds; 2) Charges released from traps and defects escape beyond the Coulomb zone and, accelerated by the external electric field, perturb macromolecular bonds dynamically; and 3) Released electrons recombine with ions and the energy released in the process perturbs macromolecules. The results also indicate that the loss of mechanical durability decreases with decreasing electric field intensity, with attendant shifting of thermoluminescence maxima and durability minima toward higher temperatures. Figures 5; references: 3 Russian.
[153-2415]

SELF-FOCUSING AND SELF-MODULATION OF ELECTROMAGNETIC WAVES IN SUPERCONDUCTOR WITH SUPERLATTICE

Gorkiy IZVESTIYA VYSHNIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 11, Nov 82 (manuscript received 1 Jun 82) pp 1231-1239

TETERVOV, A. P., Institute of Semiconductor Physics, LISSR Academy of Sciences

[Abstract] Propagation of strong electromagnetic waves through rarefied plasma in a semiconductor with a one-dimensional superlattice is analyzed, considering that such a medium is weakly nonlinear when the conduction current becomes negligible relative to the displacement current. The electric field of a wave is assumed to be parallel to a strong constant electric field also applied along the superlattice period so as to satisfy the condition for a Stark resonance of n -th order. Solution of the wave equation for a plane wave with nonlinear eikonal and negligible attenuation yields a parabolic equation for the complex amplitude. The conditions for steady self-focusing are determined, assuming that the complex amplitude varies slower along the propagation path than across it. The conditions for self-modulation of one-dimensional nonlinear waves are determined, disregarding the transverse gradients. The characteristic lengths for both effects are calculated in the nonaberrational approximation of wave propagation through a medium with cubic nonlinearity. In such a medium self-modulation of a one-dimensional wave near the fundamental Stark resonance is equivalent to self-focusing of a two-dimensional beam in time. In a special case there exists a solution in the form of a kink-soliton. The author thanks F. G. Bass and A. Yu. Matulis for their interest and discussion of the results. Tables 1; references: 11 Russian. [157-2415]

UDC 651.83

FACTOGRAPHIC CARD FILES FOR RADIO DESIGNER

Moscow RADIOTEKHNIKA in Russian No 2, Feb 83 (manuscript received after completion, 7 Sep 82) pp 87-89

MAKHOTENKO, Yu. A.

[Abstract] Engineering card files serving as an extension of a designer's memory are organized most expediently from the standpoint of data systematization and retrievability. The tree concept is applied to the file structure, essentially a hierarchic one, and three rules of organization are stipulated: 1) Each vertex of the tree must appear in the file twice; 2) The file contains two kinds of cards, one with the title entry followed by subordinate entries indicating further itemization and one with the title entry followed by subordinate entries indicating alternative realization methods; and 3) On each card inside the tree under the title entry must appear subtitle entries with

the increasable part of the index number assigned to the first (reference) subtitle. The card file with facts and graphs should be built economically, with necessary adjustments along the way, by the same group of individuals from beginning to end. Any even slightly questionable branching should be avoided. The card file should contain a complete collection of available information, with provisions for unlimited future buildup. Its data structure should be universal, applicable to any particular subject matter. A fragment of a card file on lasers is shown for illustration. Figures 3; references: 2 Russian.
[186-2415]

UDC 681.828.3

ELECTRONIC SYNTHESIZER OF VISUAL MUSIC IMAGES ON COLOR SCREEN OF ELECTRON-BEAM TUBE

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 2, Feb 83 pp 51-54

BUKATIN, V. P. and SAYFULLIN, R. F., Kazan Institute of Aviation imeni A. N. Tupolev

[Abstract] A synthesizer of visual music images has been developed at the Kazan Institute of Aviation, as a result of experimental research which was begun in 1975. The images are displayed on the color screen of an electron-beam tube, with generators of functional voltages replacing stencils as memory devices. These voltages, of frequencies equal to the sweep line or frame frequency respectively, produce diverse images changing in accordance with a given program. Each image has six basic characteristics controllable by external action and determining the program of the show: configuration, change (periodic or random) of color or brightness gradation within a configuration or outside it in the background, change (discrete or smooth) of dimensions relative to the original one, displacement (vertical, horizontal, oblique, perspective= smooth change of scale) in the plane of the television screen, brightness determined by the magnitude of the controlling sound signal and varying directly or inversely (contrapuntally) with loudness, and coloration combining two objective parameters (color tone and degree of saturation). The synthesizer consists of a synchronizing generator, a moving and pulsing module with commutator switch, a moire module, a noise module, six generators of functional voltages, an images commutator switch, a subtractions commutator switch, and an analyzer of music program with commutator switch. A generator of functional voltages has two channels, a line channel and a frame channel, each consisting of a driven multivibrator and two voltage waveform converters in series and both feeding an adder whose output is compared with a control voltage. The synthesizer can be operated automatically or manually with flexible image control. Figures 5; references: 5 Russian.
[189-2419]

SCIENTIFIC-TECHNICAL CONFERENCE ON OPTIMIZING FUEL-ENERGY BALANCE OF ELECTRIC POWER PLANTS IN MIDDLE ASIAN ASSOCIATED POWER SYSTEM FOR PERIOD UP TO 1990

Moscow ELEKTRICHESKIYE STANTSII in Russian No. 1., Nov 82 pp 76-77

SOKOLOVA, L. A., engineer, All-Union Order of the October Revolution State Planning-Surveying and Scientific-Research Institute of Power Systems and Electric Networks, Middle Asian Division

[Abstract] A conference held in Tashkent and attended by representatives from 26 organizations of Moscow, Tashkent, Leningrad, Alma-Ata and Dushanbe is described. About 90 specialists were present from operational, research and design organizations, power associations and institutions of higher learning. The work of the conference was divided into three main areas: prospects for development of power within the zone of action of the Middle Asian Associated Power System and its separate parts in the light of resolutions of the Twenty-Sixth CPSU Congress; methods of optimizing the fuel balance of electric power plants by using mathematical economics models and third-generation computers; reserves for economy of fuel-energy resources in planning long-range operation of electric power plants. More than 25 papers and reports were heard and discussed relating to analysis of regional peculiarities of formation of the present and future fuel balance of power plants and the outlook for development of power in Soviet Middle Asia, individual republics, and especially Uzbekistan. It was concluded that coordination must be intensified in research by organizations of the State Planning Commission, the Academy of Sciences, the Ministry of Power and the Ministry of Higher Education on utilizing local fuel-energy resources for electric power production, on the efficacy of importing energy resources from other regions, and on using programs and methods for finding reserves for economizing on fuel-energy resources.
[182-6610]

CONFERENCE OF INTERNATIONAL WORKING GROUP 'PILOT SECRETARIAT' OF INTERNATIONAL ORGANIZATION FOR LEGAL METROLOGY ON 'TEACHING OF METROLOGY'

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 83 pp 65-66

NEMCHINOV, Yu. B.

[Abstract] A conference on teaching of metrology was held in September 1982 at Odessa by the international working group Pilot Secretariat (PS 31) of the International Organization for Legal Metrology (MESM). It was attended by delegates from the USSR, Bulgaria, Cuba and France, also by representatives of the International Bureau of Legal Metrology (MBLM), UNESCO and CEMA. The conference heard and discussed progress reports on training of graduate engineers and metrologist-technicians. Related topics included textbooks and dictionaries, definitions and terminology, and cooperation with other international agencies. Projects and plans for the 1983-85 period were reviewed and adjusted. The

group has existed since 1978 and held its previous conference in 1980 in Tashkent. It is structured so as to include work teams (Lecturers' Bureaus) for "training of graduate metrologist-engineers" (USSR), "training of graduate metrologist-technicians" (France), and "improving the qualifications of metrologists at all levels" (FRG). Member countries of this group are now USSR, Bulgaria, Romania, Cuba, US, France, UK, FRG, Norway, Morocco and Tanzania. Participating countries are Australia, Arab Republic of Egypt, GDR, Korean National Democratic Republic, Czechoslovakia, Yugoslavia and Japan. [187-2415]

ALL-UNION CONFERENCE ON PROBLEMS PERTAINING TO IMPROVEMENT OF PERFORMANCE OF SYNCHRONIZATION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 pp 61-62

BURIZYKO, B. P.

[Abstract] The second All-Union Scientific-Technical Conference on improving the performance of synchronization systems was held at Kaunas in June 1982. It was organized by the Central board and the Lithuanian SSR board of the Scientific-Technical Radio Engineering, Electronics and Communications Society (Imeni A. S. Popov), with participation of the USSR Ministry of Communications, the Ministries of Communications Equipment Industry, Radio Industry, Electronics Industry, USSR and Lithuanian SSR Ministries of Higher and Secondary Special Education, USSR and Lithuanian SSR Academies of Sciences. The presentations and discussions covered synchronization as a physical process and synchronization in oscillatory systems, principles of frequency-time locking in digital systems, phase locking under random perturbations, synchronization in optimum radio engineering systems as a problem of matching, synchronization in receivers and signal processing equipment, and analytical-numerical methods of solving nonlinear problems of phase synchronization. On the basis of this review of present status and trends, recommendations were made with regard to further activities in various areas of improvement of synchronization systems. These include synchronization of integrated digital communication networks, centralized synchronization of television complexes, development and extended use of phase locking and frequency locking equipment, development of low-cost digital microcircuits with high cutoff frequencies, accelerated production of analog-to-digital and digital-to-analog converters, microprocessors, and high-speed memories. Recommendations were also made with regard to more intensive specialized study of synchronization by specialists and publication of more articles on this subject in the journals ELEKTROSVYAZ' and RADIOTEKHNIKA. All-Union Conferences on Synchronization Problems are henceforth to be held every 3 years. [119-2415]

SOVIET-ITALIAN COLLABORATION IN FIELD OF COMPUTER NETWORKS

Moscow ELEKTROSVYAZ' In Russian No 1, Jan 83 pp 61-62

LAZAREV, V. G. and DONIANTS, V. N.

[Abstract] Since the agreement of collaboration in the field of computer networks between the USSR Academy of Sciences and the Italian National Research Council was reached in 1981, two joint seminars as one specific form of this collaboration have already been held. On the Soviet side participate the Institute of Problems in Information Transmission at the USSR Academy of Sciences and the Institute of Electronics and Computer Engineering at the LaSSR Academy of Sciences; on the Italian side participate the Milano Center of European Information Network (CREI), the Center for System Research on Information Processing (CSISEI), and the Center of Applied Technological Research (CSATA). The first seminar was held in 1981 in Milano. The second seminar was held 14-24 June 1982 in Moscow. The topics discussed at the second seminar were: development of network architecture, methods of routing, methods of access, formalized description of records at various levels, and some practical aspects of computer network utilization. These topics were covered in 28 papers, 9 presented by Italian participants and 19 presented by Soviet participants. One specific item of interest in the Soviet presentation was a network of more than 12 computers of various capacities, integrated in accordance with requirements set forth by the International Standards Organization for systems with open architecture. All papers have been preprinted by the Science Council to the USSR Academy of Sciences on Cybernetics and deposited at the All-Union Institute of Scientific and Technical Information (Moscow, 1982). [172-2415]

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SOVIET UNIFIED POWER SYSTEM IN 11TH FIVE-YEAR PLAN

Moscow ELEKTRICHESTVO In Russian No 10, Oct 82 pp 1-4

MAKSIMOV, A. I., Central Dispatcher Control of Joint Power Systems of Socialist Countries, Unified Power System, USSR (TSDU YeES SSSR)

[Abstract] A review is given of the current status of the USSR Unified Power System, with consideration of regional characteristics and the main directions of development. The system incorporates nine associated power grids in Siberia, Kazakhstan, the Urals, Middle Volga, the Central Territories, the Northwest and Trans-Caucasus, and unifies 81 of the nation's 96 power systems over a territory of 7000 km from east to west and 3000 km from north to south which has a population of more than 220 million. The Unified Power System has a capacity exceeding 230 million kW, and generation of electric energy reached 1,178 billion kWh in 1981. Fossil-fuel plants account for 74.2% of the total output in the system, hydroelectric plants--19.3% and nuclear plants--6.5%. The power of 68 plants exceeds 1 million kW, and 35 plants have an output of

more than 2 million kW. Energy is exported to CEMA member nations as well as to Norway, Turkey and Finland. Unification has enabled optimization of operating conditions, resulting in reduced power demands on the individual power plants, as well as saving fuel. Main directions of development include optimization and concentration of energy capacities, achieving energy balance of economic regions, further development of main grids and raising the voltage class of transmission lines, and continuing improvement of management and control. One of the major tasks for the 11th Five-Year Plan is to increase the pace of new construction. Superhigh-voltage transmission lines are to be built for 1150 and 750 kV, as well as a 1500 kV-DC lines between Ekibastuz and the Central Territories. More than 30 million kilovars of reactive power sources must be installed in the power grids of the Unified Power System in the near future, including 5-6 million kilovars of synchronous compensators in order to reduce energy losses and improve regulating conditions. At least 6 million kW of obsolescent equipment must be retired, and fossil-fuel equipment with a total power of 8 million kW must be updated. More than 3500 breakers must be brought up to date in 110 kV lines, and 1000 breakers must be replaced. Special steps must be taken in order to reduce down time of equipment and to ensure normal service during outages. Work will continue on improving reliability, especially with increased automation, improved communications and personnel training.

[180-6610]

ROLE OF COMPUTER AND COMMUNICATION FACILITIES IN IMPROVING MANAGEMENT OF NATIONAL ECONOMY

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 82 pp 55-56

PETROVSKIY, I. B.

[Abstract] A scientific-technical conference was held in Moscow at the end of March 1982 on problems of improving the management of the national economy through utilization of computer and communication facilities. It was organized by the All-Union Scientific Research Institute of Organization and Management Problems (VNIPOU) affiliated with State Committee on Science and Technology (GKNT) of the USSR Council of Ministers. The conference also organized the Moscow City Committee of the All-Union Lenin's Communist Youth Association and the Moscow City board of the Scientific-Technical Radio Engineering, Electronics and Communications Society imeni A. S. Popov. The presentations and discussions covered organizational and legal problems of establishing an All-State automatic data gathering and processing system, present and future activities in development of software for collective-use computer systems, including basic programs for Unified System YeS computers, utilization of available algorithm and program banks, building new data banks, theory and methods of managing the national economy as well as its sectors and individual enterprises, mathematical methods of analysis and evaluation, designing collective-use information-computation centers and networks by various methods including simulation, theoretical and practical problems of data transmission by various methods (digital, integrated digital, optical, via satellite) for management of the economy, and integration of individual automatic control systems into an

All-State one. Following this review of present status and trends, the conference adopted resolutions and made recommendations with regard to further engineering activity in areas of correct, reliable and efficient utilization of computer software and data banks for management of the economy.
[113-2415]

TRENDS IN DEVELOPMENT OF RURAL WIRE BROADCASTING

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 83 (manuscript received after revision, 13 Jul 82) pp 11-13

KHODATAY, V. G.

[Abstract] The four major goals established for this decade in rural wire broadcasting are: 1) Adding the third program; 2) Improving the quality of sound transmission; 3) Lengthening the useful life of rediffusion stations; and 4) Increasing the reliability of networks. A major problem here is funding, in view of the fact that existing rural wire broadcasting has not been economical for both technical and demographic reasons. All indicators suggest that further development of rural wire broadcasting ought to be incorporated in the development of rural telephone communications. This will require better utilization of existing equipment, particularly of multipair cables with available large reserve capacity, as well as the expansion of existing facilities in rural (kolkhoz and sovkhoz) communication and broadcasting centers, and the introduction of special-purpose equipment such as 5-15 kW transmitters and two-program (second and third) receivers, which will call for a better supply of manufactured components. The problem of electromagnetic compatibility will have to be solved, by elimination of long overhead and underground feeders where preference is often given to "feederless" structures. Wire broadcasting will always have to compete with radio broadcasting, essentially on an economic basis, and will hardly replace ultrashort-wave FM and television broadcasting in areas where those have already been established. References: 5 Russian.
[172-2415]

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